Road Improvement.*

C. G. ELLIOTT, TONICA, ILL.

There are many factors which enter into this problem. Some of them are peculiar to our State, some to the various localities, while others become complex by reason of the ever capricious public mind in different sections. Public opinion is perhaps the most fickle and uncertain of all these factors; in short, it is the variable quantity in road improvement mathematics. Good roads come under the class of universal wants of at least a large portion of mankind. Some do not know how to supply this want, others know how, but are not willing to pay the price, while still others have visionary schemes by which our much abused country thoroughfares can be made to take upon themselves the completeness of city boulevards.

The way to obtain good roads is to improve the old ones, rather than to supplant them with something entirely new; to use what we already have as a step to something better, rather than to discard the whole. We must use the materials we have at hand, and the public funds that can be obtained for this purpose, in such a way that our roads, even if not made perfect, will be permanently improved. Whatever is done, should be done that it can be built upon and added to, thus making each successive step an improvement.

THE FOUNDATION.

The basis of all road improvement in our soil is drainage, both surface and subsoil. It is now no longer doubted by those who have tried it, that the best plan for obtaining a good road-base or foundation is by under-drainage. The road-surface may possess different degrees of excellence, but it is always better with an under-drained base than without one.

To obtain this first excellence, please note the following manual: If an embankment or grade does not already exist, one should be made, the crown of which should be 2 feet higher than the bottoms of the broad ditches at the sides. This embankment should be 20 feet wide, and 8 inches crowning. The ditches at the sides should be so graded as to readily carry all flood water into the nearest water course. This base, as now constructed, should be supplemented by under-drains made of first-class drain tile. When the surface ditches have removed all the water which will readily flow away through them, the soil will still be sufficiently saturated to make a spongy and unstable base for our embankment. Place parallel lines of tile about 3 feet below the bottom of the surface ditches along the base of the embankment, and they will thoroughly drain the lower stratum of soil for the entire road to a depth of nearly 5 feet below the road surface. As far as the subgrade of the road is concerned, this plan, when well carried out, leaves nothing to be desired. The surface, however, which has absorbed water from the rainfall, and retains it by reason of its puddled condition, is faulty, and can only be made complete by adding a dressing or covering of which shall be both durable and impervious to water.

The under-drainage of a road will ordinarily cost about $400 per mile, and for the amount expended no better improvement can be devised for ordinary roads than this. No smaller than 4-inch tile should be used, and as much larger as the locality and length of the lines will require.

It should be said in this connection, that the Henning Pipe Line Warp Co., of Waterloo, Indiana, have a patent which covers the use of tile for road drainage.

CATCH-PITS.

We may adapt this plan to stiff and retentive clays by making catch-pits at such intervals as seem necessary in order to give a ready entrance of surface water into the tile drains. These may be simply open pits over the tile, filled to the surface with small stones or brick bats, and are a valuable acquisition to the system of road drainage. The village of Ashkum, Ill., has drained her main street in this way, going so far as to fill the entire length of the ditches above the tile with broken stone, and the result is in every way satisfactory.

This is the plan for making roads out of our common soil, and that is what ninety-nine out of every one hundred miles of road in this State must be made of for years to come. This statement may not be of very great moment to engineers, but to the mass of the traveling public it is of great importance.

THE SURFACE.

As previously stated, the surface of a dirt road is far from perfect; but it can be made and kept much better than it is ordinarily found. Keep the surface crowning and as hard as possible when the earth is dry. The timely use of road machines made for this purpose will make this part of the work a light task. The difficulty is, however, to get such work done at the proper time. If due care is taken with the surface, most of the rainfall should be shed off towards the side ditches, and thence be quickly removed. When there are extended rains and continued travel at the same time, or when the frozen road surface is thawing in the spring, there is experienced the necessity of a more permanent covering. The work already described has made an admirable foundation for a gravel covering, and it is desirable to complete the road in this way whenever the proper material is accessible. Formerly a depth of fifteen or twenty inches of gravel was considered necessary for a good road, but with thorough under-drainage ten or twelve inches has been found sufficient. The following is a description of a two mile section of one of the leading roads near Ottawa, the county seat of La Salle county, Ill.

The general plan of the road is a crowning earth embankment, twenty-seven feet wide, with side ditches about twenty inches deeper than the center surface line. In all flat parts of the road, a drain of four-inch tile is laid two feet deep lengthwise along the center of the road, and discharging into the side ditches at convenient places. Upon the bed thus prepared, a covering of gravel one foot thick and nine feet wide is placed, and left crowning upon the surface. Earth from the side ditches, at this stage of the work, is now drawn up to the edge of the gravel to one half its height to prevent the gravel from spreading. This makes a single track gravel road with a dirt road on each side of it. It cost $1,500 per mile, the gravel being hauled two miles for the most distant part, and all of it up a hill with 100 feet rise. After a use of three years it remains in good repair and seems to please the public.

The roads in the level countries of our State, of which Ford, Livingston and Iroquois are examples, are a problem by themselves. Under the present system, the road ditches are made the drainage channels for the adjoining farms, and are immediately connected with private land drainage. When those used for main channels have been deepened, it will be possible to lower the water level of the whole country affected by them, so that farms and roads will be alike benefited. As far as my observation and experience go, it is difficult and expensive to secure a good, gravel road without close attention being given to sub-drainage. The more absorbent the soil is, the lower must the soil water be removed. This depth I believe to be 5 feet.

CULVERTS.

Small bridges and culverts are often a continued expense because of their poor construction. It is a common opinion that anything made of stone will be permanent; but unless such structures are well made, wood is just as durable and cheaper to renew. Our abutments for small bridges will bear a great improvement, for many of them are no better than ordinary cellar walls, made of small stones, lime mortar and backed with spalls. The mortar soon crumbles, the walls underwash and soon the supposed durable stone-work becomes a worthless mass. What is the remedy? First, securely pave the waterway with stones, so that the abutments cannot underwash. Second, at least one-half of the stones used should have a board-base or bed, and a thickness from 5 to 8 inches. Good hydraulic cement mortar should be used, and above all, the back of the walls should be well covered with mortar to prevent the entrance of water from the earth filling, and thereby ward off an agent of certain destruction to the stability of stone-work.

An improvement over the small box culvert is the sewer pipe culvert which has been introduced in many localities, and when of proper capacity and well-secured in place, are preferable to any other kind. In setting these pipes, the extreme ends are often secured by light stone walls, which also serve the purpose of holding the earth embankment which is placed over the pipes. These walls, like the abutments previously mentioned, soon give way. A better and cheaper plan is to use stone riprap about the ends of the culvert taking care to make the culvert long enough so that a slope of one to one may be given to the rip rap without infringing on the width of the road track. This will serve the purpose as well as a suitable retaining wall, and be less liable to injury from frost and road repairs.

RULES FOR ROAD MAKING.

The following is a brief statement of a few of the rules which the writer is accustomed to use in determining improvements for common roads.

For thickness of abutment walls, four-tenths of the vertical height.

Face batter, one and one-fourth inches per foot.

Paving for culvert waterways, ten or twelve inches thick, made by placing stones edgewise in courses crosswise of channel and slightly inclined in the direction of the current.

Area of waterway in square feet should equal one and one half times the square root of the acreage having its drainage through the culvert, in cases where the ground is moderately undulating. Least depth of covering upon sewer-pipes culverts, two feet.

Thickness of gravel upon a well-drained subgrade or base, twelve inches.

SANITARY EFFECTS.

It has doubtless occurred to you already that drainage has been presented as the *multum in parvo* of road making, the actual foundation upon which depends the success of road construction. If so, well and good. There is an attendant advantage in the plan recommended, which is equally important, and that is the additional healthfulness which must result to our homes. Though it is necessarily so, yet it seems to be a fact that where roads are provided with surface drainage only, there usually remain basins and badly graded ditches which retain water for days and weeks at a

* Abstract of a paper read at the annual meeting of the Illinois Association of Engineers, at Champaign, February 10-12, 1886.

time. Ponds by the wayside do not get sufficiently drained, and so remain to defile the otherwise pure air with the effluvia arising from the drying and decaying vegetation. Most disagreeable and even dangerous do these silent agents prove to be, if, as is often the case, a dwelling is located near some poorly drained portion of road. Road under-drainage removes this danger from the immediate vicinity, and adds, as it were, a voice of encouragement to the adjoining land owners to continue the work.

ROAD ENGINEERING.

As yet there is little asked of us in the line of common road engineering. Every board, having this matter in charge, consider themselves qualified to plan and direct all road improvements required of them, with perhaps the exception of an occasional piece of heavy work when a surveyor is called to set a few stakes. The road jobber or contractor, being a *practical* man, is conferred with when consultation and advice are thought necessary, and given entire charge of the work. In fact it is common to advertise for bids on work in which the contractor is required to make his own specifications. As a consequence of this method of procedure, the amount paid out for poor work under the name of first class work during the last twenty years has been enormous. The engineer may have opportunities for influencing the public toward correct and wise ideas upon the subject of roads, and thus be instrumental in gradually bringing about an improvement, but he need expect no remuneration, not even thanks. The public expect to pay their lawyer and physician for counsel, but not their engineer for a similar service, especially when it is upon a subject of no more magnitude than that of common roads. Our work lies largely in the direction of informing and educating the public mind on this subject, a work not especially profitable to us, but we trust it will be so to the general public. Much reform is required in this State in the management of roads, but this will be brought about when we all come to understand what a good road is, and how it may be obtained.

Municipal Engineering; Paper No. 1.*

BOSTON, MASSACHUSETTS.

(*Continued from page* 148.)

STREETS.

Superintendent of Streets.

Appointment, Duties and Assistants. This officer is appointed annually by the Mayor. He must keep the public ways of this city in proper condition for travel; make necessary repairs; have charge of the construction of new streets, widening of established streets, and of the sidewalks, gutters, fences and other street appurtenances. By streets are here meant public or accepted streets; he has nothing to do with the many miles of private streets in the City of Boston. In all his work he is limited in the amount of his expenditure by the appropriation for any specific work or class of work, and before he can construct any public way he must first be impowered to do so by the Board of Aldermen. But, with the approval of the Mayor, he controls the manner in which the appropriation shall be expended.

He is allowed, as subordinates, a deputy superintendent, one bookkeeper, three office clerks and a foreman for each district not exceeding ten in all.

He must keep in his office an exact record of the receipts and expenditures of his department, the names of all persons employed and amount paid to each and all who have furnished material. He reports annually before January 10th, giving a general statement of his expenditure and an estimate in detail of property in charge.

All notices of defects in the public streets are sent to his office; and such defects must be examined by the Superintendent or his assistants, and if he finds that the defect is of such a character as to endanger public travel and that the city is liable for damage, he must cause it to be at once repaired and must protect the public while so doing.

Opening or Breaking Streets. Whenever the Superintendent of Streets is about to construct a new street and break the surface of any public way, he must at least two weeks before beginning such work notify the Superintendents of Sewers, of Lamps and the Water-Board. If either of these departments have any work to do in such a street, it must consult and arrange with the Superintendent of Streets in order that it may be done before the street is again restored to travel. And after such notice and opportunity has been given, neither of the departments of sewers, lamps or water can, within the space of six months, break up this street at the point designated in the notice, except in case of obvious necessity and with the approval of the Mayor.

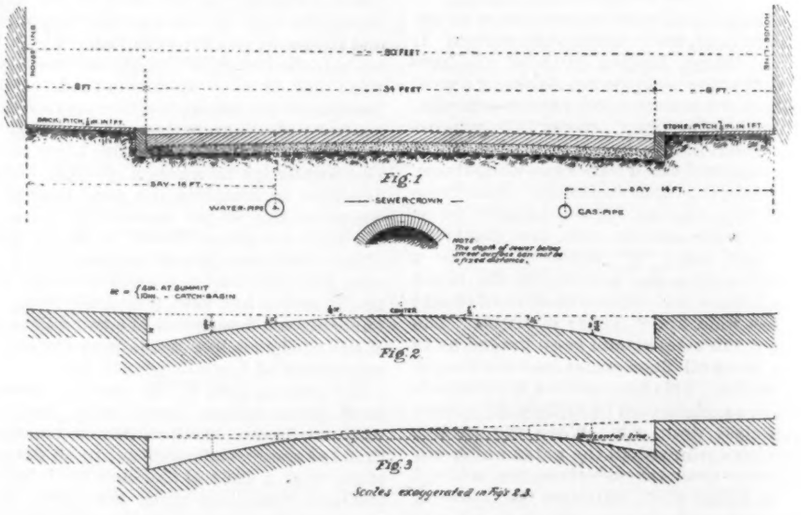

Plate 25.—Boston Street Formation.

Formation of Streets. Plate 25, Fig. 1 shows the cross-section of a Boston street, the width, however, varying with circumstances. The distance between curbs is generally controlled by the pavement width to be referred to in its proper order. In crowning a street, which has no street railway in it, the surface at the center just touches a line connecting the tops of the opposite curbs. The vertical curve given the surface across the roadway is practically arrived at by calling the depth at the gutter, below the top of the curbstone x, and then dividing the distance across into, say eight parts, sinking the points from the center towards the curb, $\frac{1}{16}x$, $\frac{1}{4}x$ and $\frac{9}{16}x$ respectively below the line connecting the tops of the curbs. This is shown in Plate 25, Fig. 2, where one side gives the proportionate drop and the other the inches and fractions for that depth of the gutter. The same rule holds good for cases where the curb on one side of the street is higher than on the other, excepting that in this case the line connecting the curbs will not be level (Fig. 3). When a nicer crowning is desired the divisions given above can be again subdivided with the same general proportions maintained. With a double line of street railway tracks in the street, the Boston practice is to drop the outer rail of each track one inch below the rail nearest the center of the street.

The standard depth of the gutter below the top of curbs is 10 inches at the catch-basins and 4 inches on summits. The general intention in crowning the street is to pass the water as rapidly as possible into the gutters and to prevent, if possible, this water from flowing down the center third of the street. Experience with the climate and the snow and slush of winter has made the Superintendent of Boston streets demand that no street in that city shall have in its length a less gradient than 0.6 feet in each 100 feet. On comparatively level streets, the catch-basins are located not less than 250 feet apart. Beneath the street surface, the water-pipe is generally laid at one-third the total width of the street and 5 feet below the surface to center of pipe; the gas main is on the other side and slightly nearer the house line, while the sewer is under the center at a depth dependent upon the street gradient and the average depth of the cellars of the houses.

Sidewalks and Curbing.—As a rule the sidewalks of Boston are made of brick, laid flat, and at right angles to the house-line; comparatively little of the "herring-bone" work is seen. Wherever possible, the width of the sidewalk is taken at the nearest foot to one-sixth of the total width of the street; *i. e.*, as shown in the figure, for a street 50 feet wide from house to house, the sidewalks would be each 8 feet wide. A pitch towards the gutter of one-half inch in one foot is given to brick sidewalks, and one-fourth inch in one foot to a stone pavement. The curbing is almost exclusively granite, and the standard dimensions are from 7 to 8 inches wide and at least 20 inches deep; the front of the curb to a depth of 10 inches, the back to a depth of 4 inches and the top of the curbstone are well dressed. The city owns all public streets in fee, including the sidewalks. When parties owning a private street, without sidewalks, offer such street to the city for its acceptance, half the cost of the sidewalk and curbing is assessed upon the abuttors. If there is a sidewalk, the city pays all the expense of re-adjusting it to any new grade in such a case.

Street Paving.—The business streets of Boston are well paved with granite blocks. Wood pavements have been tried on streets in the

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dwelling portions of the city, of the better class, but its use has been discontinued within the last three years, owing to its speedy decay, and it has been generally replaced by asphalt pavement laid by the Barber Asphalt Co. In some portions of the city, the old cobble-stone pavement, which formerly covered the entire city, is still to be found; the cobble-stone removed from the heart of the city has been utilized in the formation of gutters in the outlying districts, where the streets themselves are either well rolled macadam or gravel. The so-called "Boston" paving block of granite is about 4 inches wide, 8 inches deep and 7½ to 8 inches long; lately the "New York" block, 10 to 12 inches long, has been introduced. The "Boston" block is considered as having advantages; for, at the present time, they cost $42 per 1,000 and lay

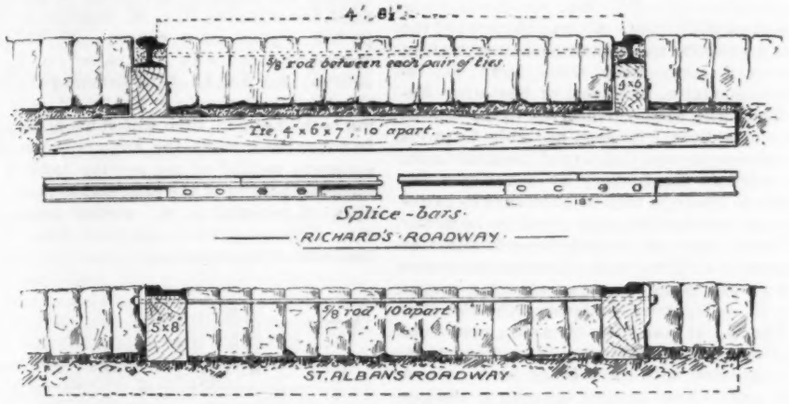

Plate 26.—Types of Boston Street Railways.

about 33 to the square yard, while the "New York" block costs $67 and lays 24 to 26 to the yard. In street paving, the city buys the material and lets out the labor only, when it does not also furnish that; in any case it prepares the street surface; upon this is put a covering of 4 to 6 inches of screened sand or gravel, and on this are set the blocks. The asphalt pavements are 2 inches thick, with a base of 6 inches of cement-concrete. In 1885, the cost of block-stone pavement was $2.50 to $3.00 per square yard, including all ordinary expenses.

Roof-Water Disposal.—The law of the city is, that no conductor of rain-water shall discharge upon the sidewalk. But this ordinance is evidently not enforced, as gutters across the pavement abound even in the heart of the city. When the law is complied with, the usual practice is to have the tin or other conductor empty into a 4-inch light cast-iron pipe about 10 feet long, this iron pipe connecting by a quarter-turn under the pavement with a 6-inch vitrified pipe leading to the sewer. Lately an attempt has been made to have all such rain-water conductors trapped before entering the sewer; but, as near as we can learn, such an arrangement is the exception rather than the rule.

Street Sprinkling.—In the thickly built-up portions of the city the streets are sprinkled by private contractors, who are paid by the abuttors. The watering carts employed vary in design; the usual form is an upright wooden tank holding about 500 gallons, though the "Monitor" pattern is also found. From April to November these contractors generally water each street twice a day on their route, often using salt-water for this purpose. The city does no street-sprinkling, except upon the outlying and thinly built-up avenues; and it is done there for the better preservation of the road surface only.

Street Obstructions.—The city ordinances abound in regulations referring to obstructions of the public highways; but we are creditably informed that the great majority of these laws are very seldom enforced. To give a general idea, however, of the law in the case, in Boston, we quote the essence of some of the more prominent of these city ordinances.

A license is required to construct or maintain a cellar-door entrance from a sidewalk, where such entrance is to be kept open; and no one can keep a cellar-door open for more than 15 minutes at a time, or two hours in all during the day without a license. No grating with spaces more than 1½ inches wide can be placed in a sidewalk and no grating can project more than 18 inches into the street, or can be put into the street at all without a license. All coal-holes or other openings in the sidewalk (excepting cellar-door ways) must be constructed of iron and glass. No sign, show-bill, lantern, etc., will be allowed to project more than one foot into the street, and all such obstructions must not be less than 9 feet above the pavement; the same rule applies to goods and merchandise. Permission must be obtained from the Superintendent of Lamps to erect any canopy, shade or awning within the limits of the street. Boxes, casks, building material, etc. will not be allowed to remain on a sidewalk for more than five minutes, (there is a special permit for building material to be referred to later), and no coal or firewood will be permitted in a street for more than 30 minutes after sunset. No vehicle more than 10 feet wide can pass through a public street without a permit.

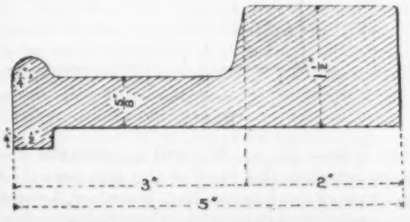

Plate 26a.—St Albans Rail. Half-size.

Coal-Holes and Vaults under Sidewalks.—The law defines the material and construction of such openings, and a license must first be obtained from the Superintendent of Streets. The ordinance requires that every coal-hole or vault under a sidewalk should be constructed as follows:—The outer wall next to the carriage way shall be made of heavy granite, not less than 2½ feet in thickness, laid with good cement, and no part of it shall project beyond the curb; the sides shall be at least 1 foot thick, and made of good, hard brick or granite, laid in cement mortar; the top shall either be a brick arch, or arches; rough-hammered granite at least 1 foot thick; North River flag-stone at least 6 inches thick, or iron and glass, or rough surface iron "similar to the Hyatt Light, so called." The hole or vault must not be more than 11 feet deep measured from the sidewalk. The opening in the sidewalk must not exceed 18 inches in diameter, and must be covered with a roughened iron plate. The owner of the estate, or occupant or tenant, before which this vault lies, is responsible to the city for any damage to person or property in consequence of defective construction, or from leaving the opening in the sidewalk open or insecurely fastened.

No boiler, steam-shaft, furnace or steam-pipe, cess-pool or water-closet can be located in a coal-hole or vault under the sidewalk. And no explosive substance or inflammable oil can be stored there; nor can the coal-hole be ventilated into a street.

Street Railways.—The Metropolitan Street Railway Co., the oldest of the eight companies owing the street railways of Boston, was incorporated in 1853, but ran no cars over its track until 1856. The following statistics of the street railway system of Boston are taken from the report of the Massachusetts Railway Commissioners for January, 1885:—

Company.	Miles of Track.	Passengers carried in 1884.	No. of Horses.	No. of Cars.	No. of Men Employed.	Total Property.
Metropolitan	78	34,57[illegible],135	3,183	664	1,499	$3,881,191.75
Highland	19	10,452,441	909	179	356	1,340,546.20
Middlesex	18	7,099,892	601	136	275	1,365,812.83
South Boston	13	9,706,299	857	193	349	963,631.24
Lynn and Boston	35	6,364,009	608	134	259	659,580.19
Cambridge	44	11,919,698	1,435	245	497	2,280,943.66
Charles River	11	2,446,152	276	48	131	368,646.00

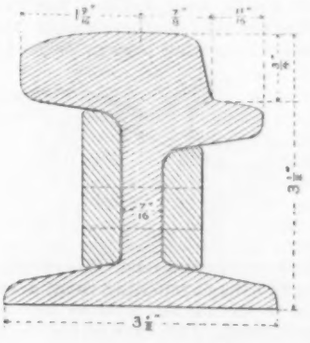

Plate 27.—Richards Rail. Half-size.

Since the above report at least two of the lines have increased their mileage, as the length of the Metropolitan railway is now 85.193 miles, and the Lynn and Boston, 43.98 miles.

The standard gauge on all the Boston street railways is 4 feet 8½ inches. The rail in most general use is the St. Alban's pattern, made originally at St. Albans, Vermont, (see Plate, 26 *a*). It is an outside bearing steel rail and weighs from 48 to 56 pounds per lineal yard. A center-bearing rail is also used on several short lines, but it is objected to as furnishing two ruts to get out of in leaving the track with an ordinary vehicle.

Plate 26, Fig. 1, shows the ordinary manner of laying the St. Albans roadway; the longitudinal stringer is 5 × 8 inches spruce, and they are tied together at intervals of about 10 feet by ¾-inch rods passing through the timbers and long cast-iron washers outside and catching the rail; the rods have nuts at each end. The cross-ties are usually about 7 feet long, and are hewed chestnut or white cedar; they are spaced from 6 to 10 feet apart. The paving outside the track is flush with the top

of the rail; between the rails the paving is depressed slightly as shown. The street railway company is required to pave between its rails and 18 inches outside of track, and to maintain this pavement. The standard distance between centers of tracks of a double line is 8 feet 8½ inches, or 4 feet between inside rails.

In the latter part of 1885, the Metropolitan Company introduced the Richards' patent rail, (Plate 27); this is a steel T-rail weighing about 35 pounds per yard and of the dimensions shown. The method of laying this rail is illustrated in Plate 20, Fig. 2. The paving is laid against the rail and flush with the top of the rail; the space thus left for the wheel-flange is small, and objections are made that this space will pack with snow, ice or street detritus and give trouble. But from an experience of some years on the Lynn street railway, laid with a somewhat similar rail, the Metropolitan Company is sanguine as to results.

The city ordinances limit the speed of street cars to 6 miles per hour in the heart of the city and to 7 miles in other streets. The use of brine or salt on the tracks is prohibited, except by permission of the Board of Health.

The street railway service in Boston is unsatisfactory at this time, and blocks and long halts are of frequent occurrence. The question of rapid transit of some improved kind is being seriously considered.

TO BE CONTINUED.

Automatic Sluices, with either Surface or Delivery Constant.

Translated for ENGINEERING NEWS from *Le Genie Civil.*

When a main canal *A* (Fig. 1) has branching from it several distributing canals *B*, there are several problems that present themselves.

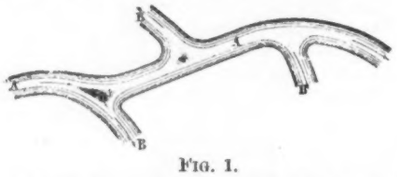

FIG. 1.

With Level Constant.—1st. To obtain at the entrance to the distributing canal a constant level, even though this level be less than in the main canal. This case will present itself, for example, when a quantity of water necessary to operate a motor is taken from the main canal.

2nd. To obtain a constant level in the main canal itself, with the distributing canal transformed into a waste-channel. To use for this purpose a bottom sluice-gate is infinitely more precise than the application of a waste-weir, even when the latter is very large; for the sheet of water on the weir is very variable in depth. This case will present itself when the main canal serves as the feeding race to a mill.

With Delivery Constant.—When the main canal is required to furnish to each derivation canal a constant volume. This case presents itself in irrigation works where each riparian proprietor desires to withdraw from the canal a volume of water strictly equivalent to his quota; or, when the canal owners, on the other hand, have an interest in proportioning the allowance of water. It is a water-meter in fact.

We will first explain the construction of a sluice-gate or orifice with delivery constant, and from that we will deduce the sluice with level constant.

Supposing the problem determined, we would remark that in a case where the delivery of the derivation canal is constant, the levels in the main canal and in this side channel will vary with each instant of time, and be entirely independent of each other. As an example: a sudden flood will raise the level of the canal; if the consumer has in no wise modified the adjustment of his sluices, the regimen of the derivation canal will re-

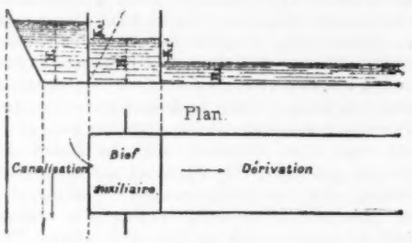

FIG. 2.

main absolutely fixed. So, too, the level of the canal possessing a constant regimen at a given moment, if a consumer shuts down, for instance, his sluice, the levels of the other distributors will raise themselves to the degree that the sluices left open are able to profit from the suppressed delivery of the shut sluice.

To regulate the delivery by means of a difference in levels, it will be necessary to introduce an intermediate race chamber in which the water level can be always maintained at a constant height: $H_0 - H_1 = K_0$ below the level of the main canal; or raised a height $H_1 - H_2 = K_1$ above the level of the distributor (Fig. 2), It goes without saying that these two levels, whose difference is kept constant, are connected with each other by a bottom sluice gate whose gauged opening a defines the delivery,

$$D_0 = a\,w\,\sqrt{K_0},\quad D = a\,w\,\sqrt{K_1};$$

that, on the other hand, the two independent levels communicating by the movable regulating sluice of the apparatus K_0 and K_1 should be reduced in volume as much as possible, so that under all conditions the loss of too large a charge of water may be avoided.

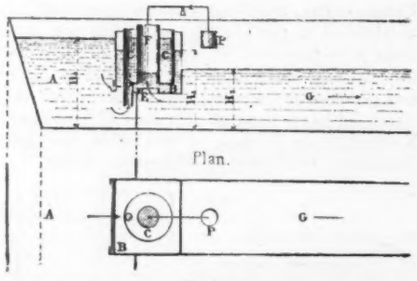

FIG. 3.

First Case, Fig. 3. We will regulate the distance between the level of the main canal *A* and that of the intermediate chamber, formed by a reservoir *B* shaped like a parallelopipedon. The liquid passes from *A* into *B* by the fixed sluice *W*. Into the liquid in the reservoir *B* plunges a movable, cylindrical, uncovered tank *C*, of which the interior is put into communication with the liquid in the chamber *A* by a vertical tube *D* fixed in the bottom of this tank and passing through the division forming the bottom of the chamber *B*, with as small an opening as possible. This communicating tube *D* simply permits the water in the movable tank *C* to assume exactly the same level as the water in the chamber or canal *A*. The orifice *W* is large enough to permit us to neglect the slight volume of water escaping from the chamber *B* around the tube *D*. This jet *A* simply adds its value to that of the orifice *W*, which becomes in reality, therefore, $W + A$. The tank *C* thus arranged is then a moving body in which the apparent weight is composed of two parts $(H_0 - H_1) + T$; T being a constant tare, we are able to balance the weight by a beam and a counter-weight for whatever value we wish of $(H_0\ H_1)$. The bottom of the moving tank *C* forms the escape sluice of the chamber *B*; this bottom resting simply upon a cylindrical open seat *E*. A vertical cylinder *F* of the same diameter as the seat *E*, disposed in the center of the moving tank *C*, and communicating by its center with the liquid contained in the seat *E*, produces a constant equilibrium in this closing device, which by reason of this arrangement finds itself free from any vertical force varying with the difference of level in the chambers *B* and *C*.

The apparatus being thus arranged, we will suppose that the flow from the canal is increased for example: the sluice *W* remaining fixed, the distance $H_0 - H_1$ ought to increase. By this, H_0 and as a consequence the liquid contained in the tank *C* is raised; or H_1, that is to say, the height of the submerged part of this tank is lowered; or finally, $H_0 - H_1$ having both changed, their difference is increased. In these three cases the augmentation of the apparent weight of the moving tank *C* produces a choking of the exit sluice *E*, and the delivery remains at its normal value. The same reasoning will hold good for a fall in the level of the main canal.

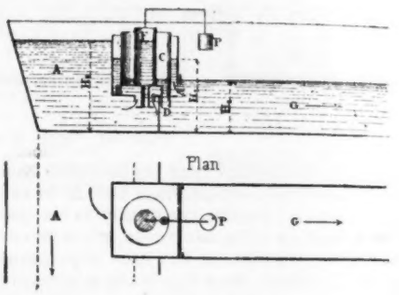

FIG. 4.

Second Case. The Inverse Solution of the Same Problem.—If the current in the main canal had a considerable velocity, this fact would produce an eddy around the orifice *W*, and the preceding solution would require, to be absolutely exact, that the water be taken from the derivation canal itself and at a certain distance of branching off. If we wished to draw the water directly into the main canal, it would perhaps be better to regulate, by means of a movable sluice-gate, the admission of water into the reservoir *B*. This is the second case, where $(H_1 - H_2)$ is rendered constant. Fig. 4 shows sufficiently well the manner of construction to be adopted for obtaining a result just the reverse of that shown in Fig. 3.

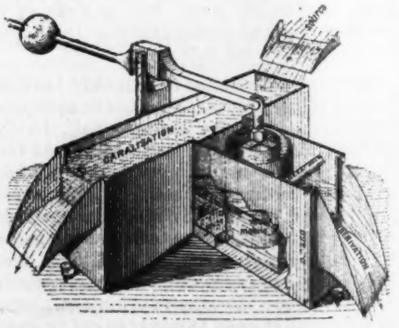

FIG. 5.

The apparatus shown in the mechanical gallery of the Exhibition at Antwerp (Fig. 5) proves with the greatest precision the results

expected from the preceding theory. The two water courses, the main and derivation canals, have been represented by rectangular, elongated troughs, placed at right angles to each other and separated by the intermediary chamber. These troughs are provided at the ends with weirs which can be raised at will. Whatever may be the altitude of the water levels in the main canal fed by a supply of considerable volume, or in the derivation canal fed by the moving sluice of the auxiliary chamber, the delivery from the weir on the derivation canal is absolutely constant and is equal to *R*. The surplus furnished by the supplying source is poured over the weir at the end of the main canal.

To vary the value of *K*, we can either increase the tare of the counter weight of the moving tank *C* by means of additional weights, or modify by the orifice *W* by means of a sliding gate.

Some Notes on Different Systems of Water Supply.

Written for ENGINEERING NEWS.

BY GEO. C. FRANCIS, C. E.

The time has come when every city, town and village is asking the question, what shall we do for a *water supply* both for fire and domestic purposes? In the past few decades the human mind has so developed methods and machinery, that it is now possible for almost any community to enjoy the blessing of pure water at a minimum cost.

When a community has decided to investigate the possibility of supplying themselves with this desirable article, the first question is: By what *method* best fitted to our conditions, can we secure a supply? In this article the writer has tried to name some of the different systems and the general conditions favorable to each, also an attempt is made to show which system is most applicable to the many different styles of districts which are to be supplied. Large cities are already supplied, to a greater or less extent, some of them with complicated systems. It is not with these that the question of system to be selected arises; but with the thousands of young and growing towns. It is chiefly the latter that the writer has in mind, naming facts which should be understood, not only by hydraulic engineers, but by any man who has to do with the question of water supply.

The acme of desirable conditions, for a water-works system, would be obtained by having, in the close vicinity of the district to be supplied, a natural pond, lake or reservoir of pure water, fed by a stream or springs of sufficient volume, at a suitable elevation to give the requisite pressure, ready to be tapped by the distribution system.

The further we depart from these conditions the more complicated the works become.

CLASSIFICATION OF SYSTEMS IN ORDER OF MERIT.

1st. A naturally impounded gravity system, as the tapping of a natural reservoir.

2nd. An artificially impounded gravity system, or the damming of streams or water-shed for a reservoir.

3rd. A gravity system, by pumping into a reservoir.

4th. A modified gravity system, or pumping into a water tower, stand-pipe, or small reservoir, with power to pump direct into mains of distribution system.

5th. A direct pumping system, or pumping into distribution pipes, with no intermediate reservoir.

Before selecting the first system, it is necessary to know whether the body of water is at a suitable elevation above the district to be supplied. This may vary from a few feet to several hundred. If near by, a height of 150 feet would be suitable to give pressure for fire hose without the use of a fire engine. If the district is partly above and partly below the reservoir, it may be wise to divide the system and supply the lower part in one way and the upper part in another. Investigation must also determine if the supply will be equal to the demand.

With the second system the reservoir must be within reasonable distance of the district, which distance depends on the cost of a pipe line leading to it, and the loss of head, owing to the length and size of such pipe. The streams or water-shed, must be of sufficient size to provide the quantity to be used, and in case they are not sufficient during the dry or summer months, the reservoir, or system of reservoirs, must have a storage capacity to tide over with a safe margin until rains will refill. The reservoir must also be at a suitable elevation to give the requisite pressure.

When neither of the above, first and second, systems are available, pumping is resorted to; the methods of arranging pumps and reservoirs forming the third, fourth and fifth systems.

When the third system is selected, the reservoir may be large or small, according to the district to be supplied, and must be high enough to give good pressure. The pumping machinery must be able to pump the average daily consumption for the summer months, and should be duplicated to provide against accidents. The source of supply should be ample to meet the demand which will be made upon it.

With the fourth system the water tower or small reservoir should never hold less than enough for a twenty-four hours supply. The pumping machinery must be capable of furnishing the maximum *hourly* consumption, and should always be duplicated. It will be an advantage to have the tower high enough to furnish a good fire pressure, in case of such a demand, while the pumping machinery may be at rest.

With the fifth system the pumping machinery must be capable of furnishing the maximum *hourly* consumption at the time of a fire, and must be duplicated. In the writer's opinion this system should not be used except for a district which can afford to run the risk of a sudden shut-down; of course, such risk is very greatly reduced when pumping machinery is duplicated. Where only a small amount of money is available, it would be better to have this system, even if only one set of pumping machinery is furnished, than none. For this reason it is most applicable for very small districts.

CLASSIFICATION OF DISTRICTS TO BE SUPPLIED AND SYSTEM MOST DESIRABLE FOR SAME.

1st. For districts containing a population of more than 12,000, use system 1, 2 or 3 according as the material conditions of locality may favor, giving preference to them in order named. Do not use system 4 or 5 unless the topographical nature of the district demands one of them as a secondary or high service system.

2nd. For a district containing a population of from 5,000 to 12,000, situated where the topographical conditions make it possible to construct a reservoir, which will hold a several days' supply or more, use system 1, 2 or 3, according as the natural conditions may favor. Do not depend on the pumping machine for a fire pressure.

3rd. For a district containing a population of from 5,000 to 12,000, situated on an extensive level area, use system 4. If a large city is situated in such an area it can be sub-divided and the same system used.

4th. For a district with a population of 5,000 or less, use system 1, 2, 3, 4 or 5, according as the natural conditions may favor, giving preference to them in order named.

5th. For such a district as a town, village or portion of a city of less than 5,000 population, situated on extensive level area, and where there is only money enough available for the most simple kind of a supply, use system 5.

The main question arising when the subject comes up for the first time, of supplying a district—the districts, as a rule, being small at this period—is whether, in case pumping has to be relied on, to adopt the 3rd or 5th system, perhaps, modifying the reservoir as noted in the 4th system. To still further illustrate this I add the following:

COMPARISON BETWEEN THE DIRECT PUMPING AND GRAVITY OR MODIFIED GRAVITY SYSTEMS.

1st. *As regards even pressure.* If, when the direct pumping system is used, the pumps are of necessity far from the district to be supplied, a loss of head in the district will be occasioned by friction in the main, due to an increased velocity during the hours of greatest consumption, and an uneven day and night pressure, which cannot altogether be regulated by the pumps, will be the result. This unevenness of pressure will be more or less as the size of the main is smaller or greater.

With a reservoir or water-tower, located in a district, the pressure at all hours of the day will be more even than if the water was supplied directly from the pumps through a long main. The tower acts as a regulator. For this reason a smaller main may be laid, if the tower is used to overcome this loss of head, than without the tower.

2d. *As regards pumping machinery.* In direct pumping duplicate sets of pumping-engines and boilers are necessary in order that one set may relieve the other while undergoing cleaning and repairs. If only a single set is provided there must possibly be times when the system will be valueless for fire protection. Even with two sets of machinery there will be times when one is undergoing repairs which will require several days to complete, and during this time the district is dependent on one engine for constant supply, and in case of accident to this, there will be no fire protection. Should a single destructive fire occur at such a time a populace would not hesitate to condemn the system and the judgment of those who were responsible for such a condition.

Machinery for the direct pumping system must be capable of furnishing at the rate of the *maximum hourly consumption for the year.* For example, the *average* daily consumption for the year may be 2,000,000 gallons. In summer the *maximum* daily consumption may reach as much again, or 4,000,000 gallons, and the majority of this must be furnished during the busy hours of the daytime, therefore requiring pumping machinery capable of delivering at the rate of perhaps 8,000,000 gallons per twenty-four hours, even if it only runs at its maximum capacity for one half hour in the year. When such machinery is duplicated it involves heavy cost for buildings, etc. With this system a constant force of engines and firemen must be on duty, thereby increasing the pay-roll. When a water-tower or reservoir is used, there will be periods when an entire suspension of pumping can be had for any purpose without detriment to the supply. A total failure on the part of the machinery cannot cause failure of supply without a chance to make repairs. Only one set of machinery of the average daily capacity during the summer will be required which being run only during the day-

time, providing the tower or reservoir is of sufficient height to furnish ordinary fire protection, requiring only one full shift of engineers and firemen. This will give ample time to make all necessary repairs. A supplementary engine and boilers of much smaller capacity can be furnished and used in cases of emergency. The gravity system, therefore, effects a saving in cost of machinery, buildings and maintenance.

3rd. *Chances for Sudden Failure of Supply.*—In the direct pumping system, with a single set of pumping machinery, the chances of a sudden failure of supply from various causes are great. The machinery may break down, the pumping main may burst; ice may clog the suction, or fire may destroy the buildings. These and numerous other accidents will occasion a sudden and positive stoppage for the time being. Some accidents may occur even though the machinery and pumping mains be duplicated.

By having a tower or reservoir, with even a limited supply, accidents cannot occasion a sudden cut-off of the entire supply. The machinery may fail and mains may burst, and there will always be a reserve supply, which will be of the utmost value in maintaining a protection while repairs are being made. Prudence demands this reserve supply, if it is a possible thing to get it.

4th. *In Case of Accidents to Pumping Mains.*—In the direct system, if only one pumping main is provided, the risk is run of losing the supply, in case of accident to it, and even if the main be duplicated, a serious accident to one will often involve the other by washing away its earth support or from the destruction of a bridge which they may pass over, etc.

With a tower or reservoir, a single main may be used with due regard to safety, and in case of accident to it, the supply is not entirely cut off until time enough has elapsed for an effort to effect repairs.

Various other considerations may arise, but the above are the most apparent in a general way.

The economical features of the direct pumping system are:

1st. No expense for construction of water-tower or reservoir.

2nd. No expense for leading mains from tower or reservoir.

3rd. No expense for maintenance of tower or reservoir.

The economical features of the gravity or modified gravity system are:

1st. Smaller, and with same regard for safety, less pumping mains.

2nd. Less pumping machinery, engines, boilers, etc.

3rd. Less expenditure for buildings.

4th. Less expense for maintenance.

5th. Saving to a community, in insurance rates, due to a more perfect fire protection.

The writer is satisfied that, with the exception of extreme cases, the economy of the modified gravity system over direct pumping, in the above items, will provide a tower or reservoir of sufficient size to obtain the benefits above recited.

BUILDING REGULATIONS IN PARIS.—Paris has very strict building regulations. The height of houses is fixed at 40 feet on streets less than 25 feet in width, 50 feet on streets less than 32 feet in width, 60 feet on streets less than 66 feet in width, and at 66 feet on streets, boulevards, and the like of 66 feet or more in width. Buildings set back from the streets gain a right to additional height in proportion as the width of the street is increased by the distance of the building in the rear of the street line. Seven, including the entresol, are the number of stories fixed, and it is provided that no ground floor shall be less than 9 feet in height, measured from the ceiling.

The Winooski Bridge.

Written for ENGINEERING NEWS.

BY PROF. CHAS. W. BAKER, BURLINGTON, VT.

The recently completed bridge across the Winooski river at Burlington, Vt., is a structure worthy of note, not because of its size or importance, but because the care with which the specifications were drawn and executed, is something unusual, except in bridges of much greater dimensions.

The old wooden truss having become unsafe, the authorities of the City of Burlington on March 20, 1885, called for sealed proposals in accordance with the specifications drawn by Professor V. G. Barbour, City Engineer.

The following are some of the specification requirements: Bridge to be of two spans, each 137 feet in length, 19 feet between trusses, and two 5-foot sidewalks. Live load for the trusses is 90 pounds per square foot. For flooring system and hip verticals it is 100 pounds per square foot, or 20,000 pounds on four wheels, 6 feet apart transversely and 8 longitudinally. Wind pressure 30 pounds on double the lateral surface, and is considered as a moving load. Maximum wind pressure on posts, batter braces and chords may be supposed to occur with bridge unloaded.

Adjustable members are proportioned to an increment of stress of 1,000 pounds for a ¾ inch rod, and 1,000 pounds additional for each quarter inch increase of diameter. Maximum unit stresses for tension are, in lateral and vibration rods, 15,000 pounds, in lower chord and main ties 11,000 pounds, in counters, hip verticals and lower flanges of floor beams 9,000 pounds. Maximum unit stress for compression is to be that given by the formula

$$S = \frac{\dfrac{40{,}000}{1 + \dfrac{l^2}{cr^2}}}{4 + \dfrac{l}{30d}}$$

where S = maximum unit stress, l = length of strut in inches, r = least radius of gyration of its cross-section in inches, c = 36,000, when both ends are square, 30,000, when one end is square and one pin bearing, and 20,000, when both ends are pin bearing, d = least diameter in inches. Maximum unit stress in upper flanges of floor beams, 8,000 pounds.

Maximum unit stresses in pins are 15,000 pounds on projected bearing area, 7,500 pounds for shearing stress, 15,000 pounds for bending stress. Bed plates of wrought-iron with maximum unit pressure on masonry of 200 pounds. Friction rollers not less than 2 inches diameter and maximum pressure per lineal inch is 625 into the square root of the roller's diameter.

Use is prohibited of rods less than ⅝-inch diameter, of channels smaller than 4 inch, or in posts than 5 inch. No plate less than ½ in. thick and 1½ wide for diagonals or chords; except for filling pieces no iron lighter than ¼ inch.

In welded eyebar heads the metal behind the pinhole must not be less than the depth of bar or diameter of pin, whichever is the greater. In hammered heads it must not be less than that above or below pinhole. Area of section through center of eye perpendicular to the bar must be as a minimum that given by the table in Waddell's Iron Highway Bridges p. 20. Maximum error in size of pinholes, length of bars, or fit of pins is $\frac{1}{50}$ of an inch. Minimum pin diameter is $\frac{8}{10}$ of the depth of the deepest bar attached thereto.

Rivet pitch shall not exceed 6 inches, or 16 times thinnest outside plate, nor be less than 2½ diameters of rivet.

Fixed end of each span must be anchored to the masonry; and if the overturning moment of specified wind pressure be more than half the resisting moment of the weight of the bridge, it must be anchored at the roller end also, but must not interfere with expansion. If the frictional resistance to sliding at the roller end of the bridge be not more than double the tendency to slide produced by the wind pressure, a resistance equal to the difference between this tendency and the frictional resistance, with a factor of safety of 4, must be provided.

In response to the call for sealed proposals the following bids were presented:

Boston Bridge Co	$12,391
Phœnix Bridge Co	11,075
Detroit Bridge and Iron Works	10,538
Passaic Rolling Mill Co	10,038
Columbia Bridge Co	9,995
Canton Bridge Co	9,974
Herbert Stewart & Co	9,870
Berlin Bridge Co	9,825
Morse Bridge Co	9,380
Riverside Bridge and Iron Works	9,250
King Bridge Co	9,091
R. F. Hawkins' Iron Works	8,169

Contract awarded to R. F. Hawkins, Springfield, Mass.

The finished bridge was formally accepted by the city authorities, February 23d. It contains 191,000 pounds of iron, and the total dead weight is about 345,000 pounds, or a little over 1,200 pounds per foot. The cost of the superstructure to the City of Burlington was about $29 per lineal foot.

A novel detail of this bridge is the position of the floor beams above the bottom chord. This feature, though not required by the specifications, was asked for by Prof. Barbour and readily granted by Mr. Hawkins.

The vertical struts being formed of two latticed channels, the latticing is left off at the lower part of the strut, and the floor beam passes between the channels. It rests on a beam seat formed of plates and angles riveted to the channels. Each web of each channel is also connected by riveted angles with the web of the floor beam.

In highway bridges it is a problem of importance to make a stiff and strong connection of the floor beam with the truss, to place the sidewalks outside of the trusses and support them in a safe and convenient manner, and to cause the strains of the lower lateral tie rods to diminish, instead of increasing the deflection of the floor beams.

It is submitted that the above simple detail solves this problem in an ingenious, excellent, and economical manner.

Underground Wires in Europe and America.

It is rather interesting to learn from France that the telegraph lines along the Paris, Lyons and Mediterranean Railway have been put underground from Paris to Marseilles, a distance of four hundred miles, and are now in good working order; while from Paris to Nancy, about half the distance, the subterranean wires have for a considerable time been operated successfully. Shorter lines, both in France and Germany, have been worked underground with such satisfactory results that the practice of burying the wires for long distances is being widely adopted, as in these cases. These facts are especially interesting, as the telegraphic experts of this country have with one voice declared that no successful method of underground telegraphy has as yet been demonstrated by experiment. This assertion has been made so frequently before legislative and municipal bodies, that a well-posted reporter could, when a proposition is made to enforce the putting of the wires underground, write up in advance the speeches

which the telegraphic experts will make against the proposal. The conflict between what the electricians say in this country and what they do in Europe is puzzling. Is the nature of the electric fluid different in the old country from what it is here? Or is the vital distinction in the nature of the ground?

Perhaps an exhaustive examination of the subject might disclose that the different conditions which make underground telegraphy practicable abroad and impracticable here, lies in the nature of the corporations themselves and their respective regard for the public rights and interests. Pittsburg *Dispatch*.

Organization of the Department of Public Works in the Argentine Confederation.

The law of October 14, 1875, created the Department of Civil Engineers subordinate to the Secretary of the Interior. The great development of the Argentine Confederation during the last years, and the desire of a more accurate knowledge of the nature of their own country moved the Government to enlarge the organization of the Department of Civil Engineers. The Government proposed to the Argentine Congress in 1884 to change the Department of Civil Engineers into a Department of Public Works. The duties of this department shall be: 1. The general management of constructing and operating state railways; 2. Supervision of the construction and management of railways built by private companies with state subsidies; 3. The management and supervision of the construction and maintenance of bridges, roads, river and canal works, architectural and other structures of the State, and the supervision of all structures affecting the public interests; 4. The investigation of the geological conditions of the country and supervision of the works employed in developing the mineral resources; 5. The survey of the Government land and the completion of the State survey; 6. Regulation of all questions referring to patents, protection of labels, and to the gauging scales and measures.

The Department of Public Works shall be under a general director and be divided into three sections. The law provides for the appointments of the following offices; one general director, and one second director, one chief engineer for each section, (one for railroad, one for rivers, harbors and canals, and one for roads and bridges). These officers are also members of the "Council of Public Works." The following assistants are to be appointed: three civil engineers of the first class and three of the second class, one mechanical engineer and one assistant mechanical engineer, three inspectors for the railroads subsidized by the Government by guaranteeing the interest, and three inspectors for the state railways. Another section, consisting of a chief engineer and 20 draughtsmen attend to the draughting of plans. The section architecture consists of a chief architect, a second architect as assistant and six draughtsmen. The geological section consists of three mining engineers, the geodetic section of a geodetic engineer, six surveyors and eight assistants; thirteen engineers, each having one assistant, are provided for supervising local works.

The law stipulates that the employés of the Department of Public Works, by dismissal from government service, are forbidden to attend to private works and to take pecuniary interest, directly or indirectly, as organizer, shareholder, or in any other form, in the construction of public works. The requirements to obtain a position in this department are: that the applicant must prove that he has graduated at a scientific school, either in the Republic or in foreign countries, and that he speaks and writes the language of the country. Most of the officers provided for in this law have already been appointed.—(*Centralblatt der Bauverwaltung*, July 4th, 1885.)

Relative Safety of Travel over Asphalt and Stone Pavements.

TRANSLATED FROM "DEUTSCHE BAUZEITUNG" OF DEC. 26TH, 1885, BY E. KUICHLING, C. E.

The records of the Berlin Fire Department for the year 1884 furnish a valuable contribution to the question of the relative safety of travel over city pavements of asphalt and of stone. The statistics of accidents, or falls of horses, upon these two kinds of roadway for the four years from 1881 to 1884 inclusive, as they occurred in that department are herewith conveniently presented in tabular form, kilometers being reduced to English miles:—

Year	Total distance travelled over.	Distance travelled upon stone pavement.	Distance travelled upon asphalt pavement.	Total number of falls or accidents.	Number of falls upon stone pavement.	Number of falls upon asphalt pavement.	Average distance in miles travelled over before a fall occurs.		
							Upon both together.	Upon stone pavement.	Upon asphalt pavement.
	Miles.						Miles.		
1881	34,436	30,982	3,454	39	22	17	883	1408	201
1882	37,026	32,023	4,103	48	20	28	771	1646	147
1883	36,942	31,966	4,976	53	21	32	697	1521	155
1884	35,190	30,708	4,482	65	15	50	541	2047	90

The figures for 1884 give a more unfavorable showing for asphalt than those of any preceding year, even if the records of 1880 be considered, in which year such comparative statistics were first kept in Berlin by the Fire Department. Still more unfavorable to asphalt will the figures appear if the nature or character of the fall be regarded. In fourteen of the fifteen falls upon stone pavement in 1884, only one horse of the team was affected; whereas, of the fifty falls upon asphalt pavement, six affected both horses.

The relatively slight security of footing of rapidly running animals, which are properly trained and skillfully driven, as is the case with the horses of the Fire Department, has already been demonstrated by the statistics heretofore obtained; but a more minute examination and classification of the records will indicate the importance of accustoming the horses to the asphalt pavements, as well as to the transition from stone pavements to asphalt. The smaller the distance traversed upon an asphalt roadway by individual companies of the Fire Department, the less appears to be the security of footing of the horses, and conversely. This fact is shown by the following table, which refers to the records of 1884.

Company.	Number of miles travelled on asphalt.	Number of falls.	Average distance in miles travelled before a fall occurs.
No. 2	10.8	3	3.6
No. 1	30.4	8	3.8
No. 4	392.7	10	39.3
No. 5	996.7	13	76.7
No. 3	3058.4	16	191.2
Total	4489.0	50	90

With regard to the time of the year in which the accidents or falls recorded in 1884 occurred, the following statement is explanatory:

1881. Month.	Number of falls on stone pavement.	Number of falls on asphalt pavement.
January	3	3
February	0	6
March	1	8
April	2	2
May	0	3
June	2	4
July	1	4
August	4	5
September	0	3
October	0	4
November	2	2
December	0	5
Total	15	49

This last table shows that the greatest danger occurs in the summer months upon the stone pavements, and in the winter months upon the asphalt pavements. It thus corroborates the observations which have been made upon the ordinary traffic in the city.

NOTE. The foregoing statistics are not presented with any desire to reflect upon the American asphalt pavements, for which the claim of superiority over the recent European asphalt pavements has repeatedly been urged; but they are offered merely to call the attention of the municipal authorities throughout our country to a simple and inexpensive method of obtaining valuable statistics concerning the peculiarities of the various kinds of city pavements. The most of the work done in this direction has been undertaken by private enterprise, and hence such statistics are usually regarded with distrust by the opponents of some particular method of paving. On the other hand, if the experience gained by the well trained Fire Departments of our large cities, with regard to the characteristics of the several street pavements, could be systematically collated, it would doubtless do much towards demonstrating what kinds of roadway surfaces are best adopted to general city traffic.

E. K.

[Capt, F. V. Greene, U. S. Engineers, who who has made a continuous and close study of this subject comments as follows upon the Berlin report:

1st. These figures have a somewhat suspicious look, from the fact that the falls on granite decrease year by year and those on asphalt increase year by year. If the figures are correct it proves that the number of observations (less than 40,000 miles travelled) is not sufficient to establish results. In my own observations the record was on over 800,000 miles travelled.

2nd. From my own observations it was found that a greater part of the accidents on granite were falls on knees, caused by starting heavy loads; horses galloping to a fire are not subject to such accidents. The *Berlin observations are of a purely special character and do not include all the conditions of travel.*

3d. The views expressed in the *note* are heartily approved, and are the same as urged in my paper before the Society. These records should be taken by municipal officials, and should cover all conditions, not special as in Berlin. As American officials have not undertaken them, the Barber Asphalt Company paid the expenses of those undertaken under my direction.

4th. For years it has been known that the accidents on the French rock asphalt (the only variety of asphalt now in Berlin) were much greater than on Trinidad asphalt pavements—the body of one being limestone as fine as flour and of the other a gritty sand. But until recently, no exact observations as to the relative number of these accidents had been made. In November 1885, the record was made on Fifth Avenue on the Trinidad asphalt in front of the Worth Monument, French asphalt in front of Hotel Brunswick, and wood at Thirty-second street.

Number of horses	36000 per week.
Distance in each case	200 feet = .0378
Miles traveled "	1,360
Accidents on Trinidad asphalt	5 = 1 in 272 miles.
" " French rock asphalt	95 = 1 in 14 miles.
" " wood	29 = 1 in 47 miles.

This makes a worse showing, both absolutely and relatively, for French rock asphalt than the Berlin observations.]

ENGINEERING NEWS
AND
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ANNOUNCEMENT.

We will be obliged if subscribers who have not received the lithographed plates of the 1st and 2nd prize designs of Messrs. Hildenbrand and Schneider respectively for the Harlem river bridge, published February 20th and 27th in this journal, will notify us *at once*. By reason of an exceedingly stupid blunder of the lithographer in delivering the first plates at the wrong place, the Hildenbrand plate was not inserted in any of the copies sent out to New York and vicinity, and to the American News Co. In New York they were delivered by messenger immediately on discovery of the oversight, and they were included in the other papers of the following week. Application must be made without delay, if parties wish to secure the plate.

To Our Subscribers.

The presswork, folding, addressing and mailing of ENGINEERING NEWS, like most other weekly papers of this city, is contracted to outside parties, and *this office* has no knowledge of any mistakes or failures on the part of the contractors until complaints from subscribers are received through the mail. We pay them for well defined service, and we will be obliged if subscribers will at once make complaint in writing when everything is not up to standard—or "grade."

THE Aqueduct Commission, on March 8, resolved that Generals John Newton, George S. Greene and J. Q. A. Gillmore be appointed a Commission of Engineers to investigate the charges made against Chief Engineer B. S. Church by H. S. Craven, late Construction Engineer of the Aqueduct. The charges relate to alleged imperfect work in construction.

AMONG the prospective exhibitors at the International Exhibition at Liverpool we notice, according to an English journal, "The Æolus Waterspray General Ventilating and Electrical Engineering Company." This is no doubt an excellent concern, but what a name it *does* take to float a corporation in the "tight little island!"

J. C. RODRIGUES, in a letter to *Engineering* regarding its late editorial on English *vs*: American Locomotives, unkindly remarks that in Brazil American engines are preferred for the good work they do. On the Dom Pedro II Railroads, 98 of the 118 locomotives are American, and the other roads now prefer them, though only a few years ago there were hardly any engines from the States in Brazil. The Baldwin engine is the favorite and the representative of that firm is a most respectable English house.

WE notice that the Commission, appointed by the French Government to visit and report upon the condition of the Panama Canal, have arrived in New York on their return. This Commission spent twenty days in inspecting the line of the canal, and Maurice Luuyt, one of its members, has said that he thinks "the canal may be finished in 1889, and that the work is progressing fairly well now, but a lot of new implements and more help will be procured very soon. The money is giving out, and there is a scheme on foot to issue a number of bonds and dispose of them by lottery." The report of M. Rousseau will not be made public until it has been submitted to the French Government.

The Commission appointed by France to investigate this engineering problem was made up of Armand Rousseau, Chief Engineer of Bridges and Roads, Louis Jacquet, Abel de le Sernette and Maurice Luuyt, all of them civil engineers. And here is just wherein France differs from the United States in investigating this problem, which is just as important and interesting to us as it is to the French. We send members of the Board of Trade, "statesmen" and even naval officers, but so far civil engineers, who alone are fitted to pass judgment have been carefully ignored.

THE Philadelphia *Times* pays a well-deserved compliment to Col. William Ludlow, the retiring Chief of the Water Department, for the increased efficiency of the department as a result of his term of office.

The improvements specified are about as follows:—The withdrawal of the department from politics and its reorganization on a strictly business basis. The vigorous collection of all water rents due the city. The decrease in pumping expenses from $252,360 for 24,691 million gallons pumped in 1882 to $185,141 for 25,165 million gallons pumped in 1885. A very material reduction in the running expenses of the various works due to better machinery and enforced discipline. And the organization of a most thorough and complete topographical and hydrographical survey, covering the entire territory from which a future water supply can be derived.

This is an excellent record, and even though our Philadelphia contemporary does make a few errors of deduction in not crediting duly the very much changed political atmosphere under which Col. Ludlow accomplished his work, the ex-chief no less deserves credit for the thorough reorganization and efficient work done. The addition of new machinery and new methods and the abolition of political workers, has had its very natural result in the decrease of expenses of pumping, etc.

RUMORS from Washington point to the possible nomination of Gen. John Newton, Chief of Engineers, to the vacant Major-Generalship to succeed Gen. Pope. We heartily trust this report may be true. Gen. Newton was a brave soldier during the late war, and his record in all respects, as a soldier, engineer and man, is second to none.

THIRTEEN of the foremost American bridge building companies have united in a call to railroad managers, chief engineers, bridge engineers and manufacturers of iron and steel for structures, inviting these gentlemen to meet the representatives of the bridge companies at the Monongahela House in Pittsburg on March 16th. The purpose of this meeting is to discuss the general form of specifications under which bridges are built, the manner of inspection of material, and the requirements as to strength of material, etc.

This is a step in the right direction; and, if the question is treated in the broad, intelligent and common-sense manner, which its importance warrants and the many interests involved demand, the outcome must be of great benefit to all. The loose wording, lack of uniformity and excessive and unwarranted demands for strength of material in many bridge specifications, are a source of loss and annoyance to builders, and of unnecessary cost to company's requiring the bridges. These evils frequently arise from the doubt existing in the mind of the company's engineer as to what he really does want, and it is time this class was provided with a standard form of specifications.

War Ships for America.

The House Committee on Naval Affairs has completed its report intended to accompany the bill providing for an increase in our naval establishment. The report repeats the "oft-told, too-true tale" of our defenseless condition among the nations from a naval standpoint; and how Brazil, and even Chili, could exact tribute from our cities on the Atlantic, Pacific or Gulf coasts, and destroy property amounting to thousands of millions in value.

The committee, after pointing out the urgent necessity for the speedy construction of at least a moderate number of modern war vessels armed with the most approved guns, recommends the following types of vessels:—

The heavily armored vessels of 9,000—13,000 tons displacement, owing to their draft, could not enter any of the ports of the United States, excepting San Francisco, so they are not recommended. They advise the building of two armored cruising and battle ships of 6,000—8,000 tons displacement, with 10—12 inches of compound steel plates on belts and barbettes or turrets, and carrying four 9—12 inch guns with a number of smaller guns. These ships are to have high speed and great coal capacity.

Next, three vessels of 3,000—4,000 tons displacement, protected by armored belt, coal supply and minute cellular division, to have large coal capacity, a speed up to 19½ knots. These ships to carry a powerful battery and torpedo outfits.

Of the lighter craft, the committee recommend the construction of one torpedo-catcher

of 1,200—1,700 tons, with high speed, and four torpedo boats.

They specify that all of these ships shall be built of steel of domestic manufacture, having a tensile strength of not less than 60,000 pounds per square inch and an elongation of 25 per cent. in 8 inches. The armor likewise shall be of the best attainable quality and of domestic manufacture.

In regard to the question of building, whether in Government yards or by contract, the committee think that repairs should be done in the Government establishments, owing to the difficulty of defining the work to be done under the contract system; this is the practice among foreign naval powers, and the bill provides that "one or more" of the contemplated vessels shall be entirely constructed in U. S. navy yards. The committee, however, find it "expedient" to extend the practice of building war ships by contract, with the desirable result of encouraging private shipbuilding, and the consequent multiplication of the means of rapidly increasing our naval strength in time of need.

In framing the bill a large amount of discretionary power is left in the hands of the Secretary of the Navy, who is thus held responsible for results. It is proposed to have all the engines built by contract; but it is provided that the Secretary may construct them in Government yards if he cannot contract at fair prices.

A New Oasis in Russian Asia.

We learn from *Engineering* that the Russians propose utilizing some channels leading from the Oxus near Tchardjni into the desert, to form a new oasis. Levels taken during the autumn show, that if the river bank is cut and the channels cleared of drift in one or two places, the water will run freely for sixty or seventy miles. The agriculture of both Merv and Kiva is entirely dependent on irrigation, the one from the Murghab, and the other from the Oxus, both of which streams supply an intricate system of canals.

The nomads, who are extremely clever in making irrigation canals, are expected to establish a net-work of canals, which will convert the clayey expanse, now devoid of vegetation, into a green oasis as fertile as any in Central Asia.

As forty acres of well irrigated land will easily support a family, this project which is said to be a sober engineering design, complete in all its details, will, if carried out, probably transform those fierce robber nomads, the Turcomans, into a large and growing body of industrious and reliable farmers, producing more than enough for their own needs.

Why the substitution of this large productive population in Central Asia in place of the roving head hunting robbers, which travelers have described, should be "well calculated to set on edge the teeth of English and Indian statesmen," we leave others to decide, thinking for ourselves that the "statesmen" who object to such results where they themselves are not in power, are wasting their energies.

Let the State Law Formulate the Reports of all Water Supply Companies.

A correspondent in referring to the Statistics of American Water Works, published by this journal, puts to us some very pertinent questions regarding the refusal of water companies to answer some, and in many cases, any of the questions required for a statistical table of the kind referred to.

We can answer for the fact that whatever persistent effort can accomplish, has been done by Mr. Croes in the gathering of this information. The trouble lies almost entirely among the numerous private water companies, some of which seem to regard the forwarding of blank forms to be filled by them as an impertinent attempt at prying into their private affairs; the great majority, however, obligingly furnish the data sought.

Water supply companies in the United States already represent a vast aggregate of capital that is being almost daily added to by the construction of new works, and the relation of these companies to the general public is so intimate that all classes are interested in their welfare and should know all about them. Railroad companies, banks, insurance, manufacturing and many other corporations similar in their public service to those supplying water, are required by law to make annual reports, which are accessible to all who desire the information. And the query naturally arises, why the law is not extended so as to embrace these corporations which supply so essential a necessity as water.

In large cities where the supply is a municipal affair, annual reports are already made; but even in such cases, a State, or even a National law, would be most serviceable. At present, reports are presented in the form which best suits the official in charge; some are systematic, thorough and really of value to those who search therein for information; others are simply a woful waste of clean paper and printer's ink. The American Water Works Association is now making a vigorous fight for a much desired "uniformity of reports;" and while they are making good progress, it seems that well-framed legislation, compulsory in its effect, would be the ablest second to the initiatary step they have taken.

If done by the legislatures of the States, and it is doubtless there that this effort must first be made, the bill should be drawn up by men practically, professionally and thoroughly competent to reach the best results. The returns should embrace all water companies, public and private, great or small; they should be made to one bureau and at the same time, and they should be so framed that they will be of value to the engineer or manager as a means of comparing methods and results, and to the consumer and tax or rate payer as a check upon extravagance or incompetent management.

With all the water supply companies in a great state uniformly tabulated, with the proper detail inserted that is too often totally neglected, and the results attained by many methods and varying machinery set down in cold contrasting figures, every man connected with or interested in the subject could gain solid information. The manager or engineer who adhered to antiquated or improper methods, because he knew no better, would be compelled to mend his ways, or make room for a better man. The earnest, efficient and progressive official, on the other hand, would have the opportunity of comparing means with results and gain new ideas to be formulated for the general good. Instead of each community rolling along in its individual rut, there would be rivalry, and rivalry in this case means advance.

We, as an individual journal, are doing our part in gathering into accessible form the statistics of American water-works, and judging from the appreciation shown by a large and rapidly growing class of the infinite labor put into this work by its editor, Mr. Croes, the "Statistics" have a valued place in water-supply literature. But we must politely request that needed information be furnished, while legislatures can demand and enforce their mandates; and therein lies the important difference between the power of the individual and the State.

We earnestly trust that the good work done already by the American Water Works Association will be pushed until it reaches the legislative halls of every State, and through them every water-works in the country. The interest involved is great; it is common to engineer, manager and consumer, and the gain which must follow any systematic management of so important a class of public works must be correspondingly wide-spreading in its influences.

The Baltic and North Sea Canal.

Le Genie Civil, of February 20, 1886, contains an interesting article showing the commercial importance of the canal which the German government propose to open, connecting the Baltic and the North seas.

As previously mentioned in this journal, the canal will be almost on a direct line joining the port of Kiel on the Baltic with Brunsbuttel on the Elbe, a short distance below the important seaport of Hamburg. There is already a means of communication between these ports by way of the river Eyder and the Eyder canal, but is navigable only by vessels of very light draft, and not exceeding 100 feet in length. Of the 35,000 vessels annually passing between these seas, only 18,000 can avail themselves of the Eyder canal; the other 17,000 must double Cape Skagen, pass through the Skagerack, Cattegat, etc., with the dangerous fogs due to the latitude of 58° north. 200 ships are annually lost in this passage, counting all classes.

This canal has been a study with statesmen and engineers for a long time. In 1390, the ruler of Holstein investigated the question; Maximilian II., Emperor of Germany, took it up in 1571, and finally, in 1774, work was actually commenced, which eventually resulted in the passage by the Eyder. So matters stood until the annexation of Schleswig-Holstein, when the Hanseatic towns and the German Chambers of Commerce again investigated the subject and submitted a new project to the Reichstag. This original scheme for a ship canal connected practically the same points as the adopted line of the present; but the route was much less direct, following the old Eyder canal and the Eyder river in their meandering. The present line leaves the estuary of the Elbe, near Brunsbuttel, passes by Rendsburg, a fortified place, and finally terminates at Holtenau in the Bay of Kiel.

Its dimensions will be sufficient to permit the passage of war-ships of about 370 feet in length, 60 feet in width and 10,000 tons displacement. The depth of the canal is fixed at 29½ feet; its width at bottom, 190½ feet, and at the surface it will be 370 feet wide. Upon the banks will be constructed arsenals, docks, basins, storehouses, etc. A lock closed by thick iron gates will shut in the canal at both extremities.

The only serious point being studied by the special commission of the Reichstag, which has the matter in charge, is its enormous cost, estimated at nearly $40,000,000. Of this amount about $15,000,000 will be supplied by Prussia and the remainder by the other States of the German Empire. The expense of maintenance is estimated at $275,000.

From an engineering point of view the piercing of the canal presents no insurmountable difficulties and it will doubtless be built.

The German Government has proposed the following bill to the Reichstag:—

Art. 1. A ship canal serviceable for the German navy, shall be built from the mouth of the Elbe across Holstein to Rendsburg along

the old Eyder-canal to the Bay of Kiel, provided Prussia appropriates in advance the sum of $12,500,000, which is included in the total cost, estimated at $39,000,000.

Art. 2. The Chancellor of the Empire is authorized, to raise the necessary money, to be paid by the Empire by a loan of $26,500,000, for which interest-bearing bonds will be issued. The articles 2 to 5 of the law of January 27, 1875, referring to the negotiating of loans for the purpose of Navy and Telegraph Department, are also applied to the proposed loan.

Art. 3. Vessels, not belonging to the Imperial Navy, passing through the canal, must pay a certain toll, according to a tariff fixed by the Emperor in unison with the Bundesrath.

Art. 4. The annual payments of the Empire must be provided for in the appropriation of the Empire.

The bill is accompanied by an explanation of the proposition. Among other matters it is stated that the navigation between the harbors of the North Sea and those of the Baltic Sea, east of the line Wittow-Torp, is shortened by using the canal as follows:—

From Hamburg to the Baltic Sea 44.91 hours; from Bremerhaven 32.54; from Emden 27.69; from Amsterdam, 22.12; from Rotterdam, 22.-11; from Antwerp, 22.12; from Dunkirk, 22.35; from London, 22.36; from Hull, 15.32; from Hartlepool, 8.06; from Newcastle, 6.36 and from Leith, 3.57.

The bill is accompanied by a summary of the estimated cost, which contains the following items:

1. Right of way and damages	$2,250,000
2. Protective works of the slopes and shores and buoys for the channel through the lakes	1,800,000
3. Harbors, quays, locks, etc.	9,065,000
4. Bridges and ferries	1,875,000
5. Military structures	250,000
6. Buildings	325,000
7. Machinery	562,500
8. Incidentals	5,125,000
9. Dredging and excavating	17,725,000

The additional cost, to make the canal available in case of war is $3.950,000. If this is deducted the total cost of the canal, considered merely as a commercial work, is estimated at $35,050,000. The total cost for a canal useful for war purposes, from the Elbe to Kiel above that of a mere commercial canal from the Elbe to Eckernfoerde is $12,750,000.

Sanitary Condition of the State Capitol at Albany.

Mr. James T. Gardiner, Consulting Engineer to the Board of Health, has submitted a report on the sanitary condition of the Capitol. The investigation upon which the report is based was brought about by Dr. Milbank, one of the Commissioners of the Board, who during the last winter had five patients from one of the departments in the Capitol suffering from difficulties which he concluded grew out of the condition of the building. In this report he states that:

The air supply of the Capitol, drawn down from the level of the roof through air shafts, is in danger of contamination from drain air rising through four leaders and through two large soil pipes that discharge within 12 feet of the top of the shafts. The current down the shafts is at such a rate that the volume of air in them is changed once a minute. In its downward course the purity of the air is further endangered by nine large water-closets, the windows from which open into the air shafts. From the foot of the shafts the air is drawn over steam coils and forced by fans into the basement, from the ceiling of which hot air flues lead to the rooms above. The air, on reaching the basement, is further contaminated by foul smelling ground water, which seeps in through the foundation wall along the western side of the building; and by the air from 3,300 feet of horizontal drains, and 1,100 feet of soil and waste pipes. The two large brick drains were found to contain several inches of offensive matter, and to be connected, without trapping, with large cesspools containing nearly 400 cubic feet of accumulated filth.

The iron drain on the north side was found to be so obstructed that much filth accumulated. After leaving the basement, and rising into the apartments, it was found that in many of the rooms the air became stagnant for want of proper exit flues. The provision for bringing air into the rooms has in general been adequate while the arrangements for its outlet are very inadequate. In the western section of the Capitol, flues have been built to obviate this difficulty.

The large brick drains spoken of above were intended solely to drain the foundations, but foul water has been allowed access to them.

This Capitol was started under the care of an able engineer and an architect, but the necessities of the political surroundings soon led to commissions of practical men who were not appointed for any knowledge they possessed of arts connected with building, as "technical knowledge can always be hired." The difficulty with this theory is that the less the average business man knows of a subject, as is shown in the case of our aqueduct commissioners, for example, the more ready he is to be governed by irresponsible advice. As one result, we have the cost of construction far exceeding the engineer's estimate; as another result, we often have a general misapplication of appliances as noted above.

The Hennepin and Erie Canals.

Congress proposes to expend $6,000,000 or $7,000,000 to build the Hennepin canal and $5,000,000 to enlarge the Erie.

The fact that Congressmen are not financially interested in the pecuniary returns derived from Government expenditures often leads them (in deference to clamors of demagogues and the narrow-minded) to propose insufficient means for the improvements of water courses, which are hoped to impose wholesome and wholesale restrictions on the charges of railroads, when if dealing with their own funds they would adopt more ample means commensurate with the results desired to be obtained.

Both of the above measures seem of this class.

Three routes for the Hennepin canal have been surveyed, all starting in the pool made by the Henry dam, from a point 1¾ miles north of Hennepin, or about 17 miles south of La Salle, and having the first 25 miles in common to the summit, which is to be fed by a feeder 37.1 miles long, of the same size as the canal, which leaves the Rock river at Dixon. This summit is 205 feet above the Illinois river, and will be reached by twenty-three locks. From the summit the routes diverge, one, the *Marais d'Osier* reaching the Mississippi about 2 miles below Albany, with a total length of 64 miles, fall from the summit 75 feet, with eight locks; estimated cost $5,811,368. The *Rock Island* route enters the river below the rapids, total length 74.5 miles, fall 101 feet twelve locks; cost $6,672,891. The *Watertown* route entering near the head of the rapids will be 65.2 miles long, with a fall of 86 feet and nine locks, cost $7,207,647.

This canal is part of a combination scheme, viz., the enlargement of the old Illinois and Michigan canal from Chicago to La Salle, 100 miles, now with locks 110′ × 18′ ×6′, making a slack water navigation from La Salle to the mouth of the Illinois at Grafton on the Mississippi, 230 miles, by means of five dams with locks 350′ × 75′ × 7′ two of which are now built, and the Hennepin canal of the length above mentioned and locks 170′ × 30′ × 7′ only.

The completion of the Hennepin canal would save about one half the distance from St. Paul to Chicago over the route by the mouth of the Illinois, and about two thirds the distance from Rock Island, and there can be no doubt that it would be of great value not only to Illinois and Wisconsin with the states lying to the west, but also to the manufacturing and coal mining states to the east. The crop of wheat in the upper Mississippi states for 1884 was 188,349,000 bushels, corn 837,574,000, making a total of 1,025,922,000 bushels.

Congressman Murphy, of Iowa, shows in his report that the railroad freight from St. Paul to Chicago is from 10 to 12 cents per bushel for wheat, and he estimates that by canal it would not be more than 6 cents, adding:

"It is well known that the market value of this vast amount of grain is determined by the price that can be obtained abroad for so much of it as seeks a foreign market. The cost of production and the cost of transportation has nothing whatever to do in determining the price. It is apparent that to the producer every dollar of the cost of transportation he is obliged to pay in reaching a market which might have been saved *is a burden laid upon him without compensation for which there is no justification*;"

judiciously raising the point that a government entrusted with the power that does not take steps to cheapen transportation by improving its waterways is derelict to its duty, and like a farmer who does not avail himself of the improvements in agriculture.

It will be noticed that the locks on the Illinois are 350 feet × 75 feet and locks of the same size are proposed for the enlargement of the Illinois and Michigan canal, the Mississippi from St. Paul to Keokuk, (where the locks are 350 ft. × 80 ft.) and its tributaries is without locks; with these surroundings it is difficult to see why Major Benyaurd, the engineer in charge, should have written

"It is proposed to make the canal and feeder 80 feet wide on the water surface, and 7 feet deep with slopes of 1 or 1¼. The locks for the main canal are 170 long and 30 feet wide. These latter dimensions were adopted after considering the question of low water navigation on the Upper Mississippi * * * * but we had to be governed by the minimum draught of the boats at the most unfavorable stage of the main river."

This, in effect, is to determine that $6,000,000 or $7,000,000 shall be expended not only for a narrow gauge junction between two larger water courses, through which side-wheel boats cannot pass, but as far as possible to discourage any further improvement of the upper Mississippi.

Minneapolis and St. Paul, are as likely to have 1,000,000 inhabitants within the life of those now living as Chicago was twenty six years ago, when Horace Greely made his famous prediction, for it is the center of about all the water powers west of Buffalo.

With the probable future before that region and while the poorer nations of Europe, according to Sir Charles Hartley, consider the acquisition of a single foot of additional depth between adjacent river basins worthy of being attained at great cost, we should be willing to expend the necessary sum for the additional width demanded by the boats that conduct the commerce of the Mississippi and Illinois.

The proposed appropriation for the Erie canal is to be expended in deepening the prism of canal 2 or 3 feet and lengthening some of the lock chambers *without* widening them.

There are, not mentioning that of Canada, two interests in the Erie canal: that of Buffalo, which desires to see it enlarged and improved so that the alternative between water and rail may attract more lake freight to that city, and above all things that the transfer business is not injured by an enlargement that will allow lake vessels to pass through; and also the interest of the whole United States in the cheapening of transportation.

The expenditure of $712,390 on the St. Clair flats and at the Limekilns crossing, has increased the draft of lake vessels from 9½ feet in

1858 to 16 feet at present; with lake receipts at Buffalo increasing with each increase of depth till from 1858 to 1884 the flour and grain increased from 19,646,000 to 76,756,000 bushels, while the rate for freight from Chicago has fallen from about 25 cents to 2½ cents, while on the canal, which since 1862 has received no accession to its size, the amount of freight transported has remained about stationary.

The proposition of Mr. Sweet, the State Engineer, as presented before the American Society of Civil Engineers, is to enlarge the Erie canal to such a size that lake vessels could pass freely through it to New York without breaking bulk. This, besides cheapening transportation, would render our lake, marine and coasting vessels available either on the lakes or ocean.

Until the practicability of this plan of Mr. Sweet has been fully tested by an instrumental survey and its cost estimated, no money should be expended on the canal for such insufficient improvements as would hinder the execution of the more useful plan, nor should locks be commenced on the Hennepin canal that will be too small to accommodate the steamboats that are now plying on the Mississippi and Illinois rivers.

The Public Laundries in Paris.

The *Revue Scientifique*, of December 23, 1885, publishes an interesting paper by M. Gerardin, of the board of public health, upon the public wash-houses or laundries of Paris, of which there are two kinds, those on land and floating houses.

The houses on land number 392, and are situated in a zone which corresponds very nearly to the ancient outer boulevards, where the population is not too dense and land obtainable at reasonable rates.

The average number of stands or washing places is 90 to each establishment; but taking a typical laundry of 100 places, M. Gerardin finds that the ground occupied would be 400 square metres, or 4 square metres per place, and 20 cubic metres of air space to each. As to the consumption of water, it is found that 20 cubic metres of "city" water, and 100 cubic metres of water "from the wells," is sufficient to wash daily about 5 cubic metres of linen of all kinds; the volume of water used being thus 24 times the volume of the linen cleaned. Towards the centre of Paris 70 per cent. of the drying is done in the laundries; towards the circumference, only 20 per cent. is so disposed of, all the rest being done in courts and small gardens.

The price of "a place" is 5 centimes per hour, and the cost per day is 40, 35 or 30 centimes, according to location as regards the centre of the building. The "dryers" pay 20 to 30 centimes. The tub of 12 litres of hot water or the lye-water cost 5 centimes. The total expense amounts to about 300 francs per year for each "place," which would yield a rental of 30,000 francs per annum for a 100-place laundry.

Of the floating wash-houses there are 22 upon the Seine within Paris, and generally near the centre between the Island of St. Louis and the city. The total number of "places" is 2,300 not including six of these boats stationed on the Canal St. Martin. The average is thus 110 places each.

As compared with the land establishments, the area is greater, the service better, and the cleaning out more easy; but the cost of installation is also higher than on land and the expense of maintenance greater.

Over the whole length of the boat one sees abundance of the hypheotric vegetable growth (an algae which is developed by the waste-water) and as 126 cubic metres of linen are daily washed in these boats, it results that each day 2,772 cubic meters of water are converted into a non-potable condition.

M. Gerardin says the first scouring of dirty linen is capable of dispersing morbific germs, and he recommends that this operation be done in special vessels from which the water will pass to the steam boilers. In drying, he thinks the temperature should be made to mount up rapidly to 100° Cent., and kept there for four or five hours.

Our contemporary, *The Sanitary Engineer*, in its issue of February 4th, gives an illustrated description of the public baths and wash-houses of Glasgow.

These buildings, intended to accomplish the same purposes in aiding the poor in the cleansing of linen as the Paris establishments, add to these facilities the very important adjunct of a warm bath for the poor themselves.

There is abundant room for the introduction of similar conveniences in our own city of New York. The conditions under which the washing and drying of clothes is necessarily done among the poor of a crowded city is far from being conducive to health or comfort; and while, as in the case of Glasgow, it might take time to educate this class to a full appreciation of the advantages of the more improved method, the increased comfort and lessened expense for fuel and supplies would soon teach them that the new plan was the best for them.

At present there are literally no facilities for a warm bath by the poor in winter in this city. And the proverbial aversion to water for bathing purposes, ascribed to this class, can hardly be wondered at when ice-cold water is all there is at their command, and the opportunities very few even for the proper use of that. Many thousands are dirty simply because they have no means for making themselves clean.

With a public establishment arranged for the convenience of the laundries, and connected with it a swimming bath or baths, the water heated by the same appliances required for the laundry, two very good results would be accomplished, and a great class benefited by presenting them with the opportunity of vastly improving their condition. A clean shirt is in one sense an educator in itself, and the man is the better man for wearing it; it adds to his self-respect; but if the body beneath is also clean, the man is still further made to feel himself a man, and an incentive is given to make his surroundings less filthy

We have many good people in New York who are striving to improve with the means at their command the condition of the poor, and there is a wide field for the exercise of this charity in the direction we have pointed out. Practically their charity need go little further than the installation of the necessary buildings and appliances, for we firmly believe that the class to be benefited would soon take advantage of the increased comforts offered and make them self-supporting, if not even profitable as they are in Paris. The public gain in physical improvement would also be great. Let some of our wealthy philanthropists try the experiment, or, better still, let our municipal authorities devote some time and money, for the benefit of a very large class of their constituents. The economy might come in time in lessened expenses for the maintenance of city hospitals and penal institutions.

ENGINEERING NEWS, Three Months, One Dollar and Fifty Cents.

PERSONAL.

LUCIUS G. FISHER, an old resident of Chicago, and a well-known railroad contractor, died March 5th.

GEORGE A. ELLIS has been elected City Engineer of Springfield, Mass.

Z. HAMER has gone to Topeka, Kan., to enter upon the duties of Superintendent of Construction of the Atchison, Topeka & Santa Fe R. R.

MR. J. T. BOTTOMLY, a prominent contractor of Evansville, Ind., died at his home March 3d. He was 45 years of age.

FRANK C. GOUDY has received his appointment as General Superintendent of the Uncompahgre (Col.) Canal Company, vice Charles A. Thornton, resigned. W. H. FRANKLIN will be Assistant Superintendent.

JOSEPH FRICK, a prominent architect of Evansville, Ind., aged sixty-four years, dropped dead March 2nd., at his residence, of heart disease and aggravated asthma.

The Directors of the Peoria Terminal R. R. Company elected the following officers on the 3rd ult: D. P. PHELPS, President; GUY STOFF, Secretary and Treasurer; JOHN F. WALLACE, Chief Engineer.

JOHN DEVLIN, a well-known contractor of Brooklyn, was shot on March 8th by his brother Daniel Devlin, during an altercation following an attempt to borrow money. The five wounds received are not necessarily fatal. John Devlin was formerly a General Inspector of the City Works Department of New York, and has amassed a fortune.

CALEB B. MEEKER, late General Passenger Agent of the N. Y. Central R. R. and Harlem River R. R., died at his home in Schenectady, N. Y., on March 8th, of peritonitis. Born in 1836, Mr. Meeker entered the service of the Central R. R. in 1855, and continued with it until last year, when he resigned on account of ill health.

At the meeting of the Aqueduct Commission on Wednesday, letters were received from Engineers George S. Greene and J. Q. A. Gillmore, saying that they were willing to serve on the committee with Gen. John Newton, to try Chief Engineer B. S. Church on the charges preferred by his late subordinate, Mr Craven. Controller Loew said that Gen. Newton had signified by telegraph his willingness to serve.

MAJOR WILLIAM LUDLOW of the Corps of Engineers, U. S., A., has been appointed by the President, Engineer Commissioner of the District of Columbia, vice Major Garrett J. Lydecker, Engineer Corps, U. S. A. Major Ludlow has an excellent record as an engineer, and has had charge of important public improvements in various parts of the country. He was engineer secretary of the Lighthouse Board for several years, and while holding that office in 1883, Congress granted him leave of absence without pay in order that he might accept an offer to take charge of the waterworks of Philadelpaia, and he has just been relieved from the duties of that place.

MAJOR WILLIAM J. LIVERMORE, Corps of Engineers, has been relieved from duty as engineer officer of the Department of Texas and ordered to Kansas City, Mo., to relieve Major Charles R. Suter of charge of the improvement of the Missouri river, from its mouth to Sioux City. FIRST LIEUTENANT FRANK E. HOBBS, Ordnance Department, has been ordered from Philadelphia to Johnstown, Pa., on public business connected with the inspection of work to be done on the hoops for the ten-inch steel rifle being constructed by the Cambria Iron Company.

Engineers' Club of Philadelphia.

Record of Business Meeting, February 20th, 1886.

President Washington Jones in the chair; 38 members and 2 visitors present.

The Tellers of Election, Messrs. J. Foster Crowell and George T. Gwilliam, reported that the following had been elected Active Members of the Club: Messrs. Geo. R. Henderson, R. C. Luther, Llewellyn W. Jones, Samuel T. Wagner, Fredk. H. Lewis, Carl O. Lindroth, Phillips Bassett, Fredc. H. Robinson, W. L. Hoyt and Philip D. Borden, Jr.

Mr. J. Foster Crowell presented, in continuation of his discussion of the Interoceanic Canal Question, an exposition of the engineer-

ing features embodied in the Nicaragua Ship-Canal project in its latest form, illustrated by official maps and profiles of the country, harbors and route, accompanied by detailed plans of the dams, locks and other permanent structures furnished through the courtesy of Mr. A. G. Menocal, the Chief Engineer of the undertaking.

The paper began with a comprehensive description of the topography of the canal site, the great basin of Lake Nicaragua and the San Juan valley—claiming broadly the adaptiveness of the country to the purpose, and defining the canal location, which, in the author's opinion, has been so contrived as to fully avail of what nature has already done.

He stated that in the limited sense in which the term canal is generally used, it is a misnomer for this work, which is to be "a slack-water system of grand dimensions, wherein lake and river navigation, practically unrestricted under the treatment proposed, will constitute 128 $\frac{3}{10}$ miles, or 77 per cent. of the entire passage between the oceans, while the artificial channels will aggregate but 40 miles, or 23 per cent; and of these artificial channels, 13 miles were to be made so wide and deep as to offer no objectionable restriction, leaving only 27 miles of confined canal, divided into several separate stretches."

Mr. Crowell then proceeded to describe in detail the location of the line, noting the position of the dams, which were to establish the grand summit level of 144 miles in length, and the disposition of the locks; enlarging upon the peculiar conditions to be met in the several cases, and noting the various provisions for control and discharge of surplus water, and for disposing of the surface drainage at the points where the canals required protection therefrom.

He next exhibited drawings of the locks, of which structures there will be seven, three on the Atlantic side, and four on the Pacific, each 650 feet long, 65 feet wide, with 29 feet of water at least depth,—these drawings showing fully the various devices provided for working the gates, filling and emptying the locks, the floating moorings for ships, and the constructive features of the lock chambers; the "rolling gate," 88 feet in height, designed by Mr. Peary, U. S. N., for the great rock-hewn lock, with 53 feet lift, was fully explained.

The dam structures, of which there are to be two, were described as also the culverts, waste-weirs, etc., for taking care of small streams encountered at several points.

The breakwater and jetty system, proposed for deepening and protecting from the swell of the sea the canal entrances, were illustrated by means of charts; the author considering that, in view of the harbor in Lake Nicaragua for all purposes of through-commerce, and the enlarged prisms of the sea sections of the canal, ocean harbors were not necessary, and if constructed, would now constitute a source of superfluous expense. Mr. Crowell here pointed out the causes, which had led in the past to the destruction of the once fine sea harbor at Greytown, but claimed that it would be possible to restore it partly, but sufficiently, if, in the future, a necessity for it should arise.

The figures of rainfall, water supply and lockage requirement, were adduced. He stated that the total needs of the canal, to work it to its designed capacity of 32 double lockages per day, would be only $\frac{1}{10}$ of the mean daily flow from the lake, or $\frac{1}{4}$ of the minimum daily flow; and that, in addition to this great surplus of the lake supply, the tributary streams would discharge much more than enough water to compensate for leakage and evaporation. The paper concluded with a discussion of the estimate for construction of the entire work, amounting to $65,000,000, including an allowance of 25 per cent. for contingencies, the time required for completing the system ready for service being given at six years, with a statement of the quality and availability of material for construction to be obtained along the line. The thorough character of the surveys, location and computation were referred to, and the presumptive reliability of the information offered was stated to be exceptionally great.

Mr. Crowell supplemented the discussion by reading extracts from a letter recently published by Mr. Menocal, on the relative costs of operating the Nicaragua canal and a ship-railway, assuming, for the purpose of comparison, the capitalization and volume of traffic to be the same for each: taking the official reports of gross and net earnings of the Suez canal as the basis for estimating the probable proportion of operating expenses for Nicaragua, and assuming that the operating expenses of the railway, as is claimed by its promoters, would not exceed 50 per cent. of gross receipts; and claimed that the canal under these conditions would earn annually 100 per cent. more than the railway, not taking into consideration the further economic advantages arising from the permanent nature of the canal works, which, if properly constructed, would improve with age, as against the depreciable character of the most expensive parts of the railway and its appurtenances.

The Secretary presented a letter from Prof. J. E. Nourse, U. S. N., Correspondent, expressing the general views of Prof. Nourse upon the subject of Isthmian transits.

Dr. H. M. Chance described some rather paradoxical phenomena experienced in draining a mine by siphons. In the case of a double siphon drawing water from two sumps at different levels, the siphon, upon starting, operated satisfactorily, drawing water from both sumps, but in a few minutes the current in the branch leading to the lower sump reversed, and water was discharged *into* this sump, the main siphon continuing to work as at first. This action seems to be due to the loss of head due to friction, as the water acquires considerable velocity in the discharge by which the efficient head at the lower sump is greatly reduced.

Prof. L. M. Haupt deferred his paper on the Delaware Breakwater Harbor until the next meeting, but explained, for the benefit of the members present, a dissected model, showing the condition of the bottom before the breakwater and ice-breaker were built, the position of those structures, the scour and deposits that had occured, and the work done by the currents in the various zones lying between the several fathom contours. The volumes moved were determined by weight, and important physical results were clearly and intelligibly illustrated. The character of the forces acting in this harbor, were, in the author's opinion, easily and readily determined from the changes which had been produced in the mould of the harbor.

A discussion of the general deductions and remedies was reserved for the next meeting.

The Secretary presented, for Mr. Walter S. Church, a complete set of the New Croton Aqueduct Specifications, handsomely bound, and the thanks of the Club were returned for the same.

HOWARD MURPHY,
Secretary and Treasurer.

CORRESPONDENCE.

Embanking over Arches.

NEW YORK, March 6, 1886.

EDITOR ENGINEERING NEWS:

If your correspondent St. O. Nearch, has not already done so, and will look at Rankine's Civil Engineering, pages 423 to 436, he will find discussions as to backing and embankment over arches, I know of no American work on the subject.

CHAS. J. BATES.

Thickness of Abutments.

YONKERS, N. Y., March 8, 1886.

EDITOR ENGINEERING NEWS:

I think your correspondent Mr. St. O. Nearch, will find what he wants in an article entitled "The Proportions of Arches, derived from French practice" published in the December, 1883, number of *Van Nostrand's Engineering Magazine*. The number for February, 1884, contains a continuation of the subject from its mathematical side. These two articles contain a number of misprints, particularly the December one, but none I think affecting the figures given. E. S. G.

Thickness of Abutments.

170, CLINTON ST., BROOKLYN, N. Y.,
March 10, 1886.

EDITOR ENGINEERING NEWS:

It may interest your correspondent St. O. Nearch, to know that on a sheet of drawings of culverts for the Great Northern and Western of Ireland Railway is the following note:—" The arches and abutments shall be increased in thickness 3 inches for every unit of 10 feet in the height of embankment above that shown on the drawing."

The culverts are of coursed rubble masonry with inverts, the largest shown is 10 feet wide by 10 feet high, with a semi-circular arch; in the middle portion of the culvert the crown of the arch is 2 feet 6 inches, the haunches 3 feet, and the abutments 3 feet 6 inches, while for the end portions the dimensions are, 2 feet, 2 feet 6 inches and 3 feet respectively. The height of embankment from the extrados of the arch to formation level is about 17 feet. Another culvert of simila construction, but 5 feet 6 inches high by 5 feet wide, has the following dimensions: middle portion; arch 1 foot 8 inches, haunches 2 feet, abutments 2 feet 4 inches; end portions; arch 1 foot 4 inches, haunches 1 foot 10 inches, abutments 2 feet. The height of embankment above the arch in this latter case is 19 feet.

Yours very truly,
EDWARD E. R. TRATMAN.

Problem.

JOHNSTOWN, March 8, 1886.

EDITOR ENGINEERING NEWS:

I find in your paper, page 156, that my Problem on the Circular Field is incomplete, the field is 10⅛ acres. What must be the radius using the fence as a center to cut off one acre? SUBSCRIBER.

A Letter of Recommendation.

NEW YORK, March 8, 1886.

—— CH. ENG. —— R. R.

Dear Sir: For the past two weeks I have been bored daily by an applicant for employment as draughtsman, Carl ——, who has filed his application with you. He has requested me repeatedly to speak to you about him, and again this morning, and I have promised to do so.

Having known him for about twelve years, I can only say from intimate observation that he is a pompous humbug and an intolerable nuisance, without any qualification that I have been able to discover. If you will say to him on the occasion of his next visit that you will have no need of his services for the next five years you can, I think, save both of us much trouble. Yours, ——

News from the West.

OMAHA, March 6, 1886.

Special Correspondence ENGINEERING NEWS.

Articles of incorporation of the Cheyenne & Northern Railway Company were filed with the Secretary of Wyoming Territory, March 1st. Capital $3,000,000, divided into 30,000 shares. The incorporators and trustees for the first year are Thomas Sturgis, Secretary of the Wyoming Stock Growers' Association and President of the Stock Growers' National Bank of Cheyenne; Henry G. Hay, cashier of the same bank; Francis E. Warren, Governor of Wyoming and President of the Warren Mercantile Company and the Warren Live Stock Company; W. M. C. Irwin, Vice-President of the First National Bank of Cheyenne; Morton E. Post, banker and ex-Delegate in Congress; Joseph M. Carey, present Delegate for Wyoming; Erasmus Nagle and W. Corlett. The line of the road is from Cheyenne north to Fort Larmie, thence northwest to Fort Fetterman, and through Johnson county to Montana, thence northwest to the Northern Pacific. The company is organized upon the strength of $500,000 subsidy to be given by Larmie county to a north and south road. It will probably be operated in conjunction with the Union Pacific.

Omaha is still discussing the paving question. The Omaha *Bee* condems wood pavement, by saying that it is short lived, dirty and unhealthy.

Omaha is very much in need of some good brick manufacturers. The few located here seem to control contractors. Fuel is cheap and the clay is splendid for brick making. There will be about $3,000,000 worth of building done here this year.

Rosewater and Christie, engineers, are preparing a new map of Omaha. It will extend from the Missouri river, five miles west and eight miles north and south. It will be very complete and contain all the new improvements; the stock yards, railroad lines, etc. The scale is 500 feet to the inch. There are 230 additions to the city.

Mr. H. W. Parkhurst, the bridge superintendent, who has been so unfortunate lately, is rapidly mending and is able to be about his room.

The Montana Central Railway Company awarded contracts for the grading of forty-one miles of road on March 2d. to Hugh Kirkendall, of Helena, Mont., and A. W. McCune, of Butte. The section covered by this contract extends from Helena to the Missouri river at the mouth of Prickly Pear creek.

President Harris of the Northern Pacific announces that arrangements have been finally completed for the entrance of that company into Butte, Mont. The track of the Union Pacific will be three-railed from the junction of the two roads at Garrison to Butte, a distance of fifty-one miles.

Several official changes in the force of the Idaho Div., Union Pacific Railroad took effect on March 1st; Frank Bruen, Div. Eng'r.; J. S. Eck, Supervisor of the Bridge and Building Department; E. Braddock, General Roadmaster; Jos. A. Edson, Train Master; W. H. Hemphill, General Foreman, Mechanical Department, and F. S. Rawlins, Chief Clerk in the office of the Superintendent, all having resigned to take effect that day. The jurisdiction of D. W. Campbell, Div. Eng'r., and J. M. Bennett, Supervisor of the Oregon Short Line, is extended to cover the entire Idaho Div., and the office of General Roadmaster is abolished. No other appointments to fill vacancies have yet been announced

WATER

THE Birmingham, Ala., City Council has granted the application for new gas works on condition that gas be supplied to private consumers at not more than $2 and to public institutions at not more than $1.50 per 1,000 feet.

AT the recent meeting of the Minneapolis Water Board a contract for laying pipe was awarded to Andrew J. Dolan. The time for receiving bids for the laying of other mains was extended to April 1st.

SOUTH FRAMINGHAM, MASS., has adopted a resolution for the procuring of a better water supply by constructing a drainard for filtering purposes from the southerly part of Framingham to the Sudbury river.

THE Washington Natural Gas Company with $500,000 capital has been incorporated at Harrisburg, Pa. The company will supply Pittsburg and Allegheny City with gas from Washington county.

THE Pittsburg Pipe-Line Company is laying a 2-inch line from the Hood well to Shannopin station on the Pittsburg & Lake Erie R. R., a distance of about two miles. The intention appears to be to pump the oil into cars which will stand on a side track that is located there.

A DAM is proposed at the sand bar on Watuppa pond, Fall River, Mass., as a protection in case of flood. A suitable dam would permit of an overflow upon less valuable and more level territory, where the damage done would be comparatively small, and it is urged that it would also be instrumental in preventing excessive waste.

ASPEN, COL., March 1.—Water was turned into the new water mains for the first time to-day. A test showed that the pressure obtained is 105 pounds. The works seem to be a success in every particular. The fire companies were out all day testing the plugs at various points. Four streams were thrown at one time from the main on Mill street, and they reached a height of about seventy-five feet.

THE St. Louis Board of Public Improvements has decided upon the laying of twelve miles of new iron water pipes and mains during the coming spring and summer, principally on the streets occupied by factories, in North, and also in South St. Louis. Work will accordingly be begun at an early date, the weather permitting.

RUTLEDGE, the new suburban town near Morton, on the West Chester and Philadelphia Railroad, is to be supplied with water from an artesian well. Boring has been begun and the contractor expects to strike water at a depth of 200 feet. The works will cost about $20,000 and be supplied with a tank capable of holding 50,000 gallons.

NATURAL gas is being successfully utilized as a street cleaner. At Beaver Falls, Pa., a hose with perforated metallic nozzle was attached to the main, the gas was ignited and the mountains of snow that blockaded the streets were reduced to water in a few minutes by a powerful stream of hissing blue fire. Pittsburg people are now talking of applying the same system on an extensive scale.

THE Pond Engineering Company has contracted with the Oskaloosa, Ia., Gas Light Company for the entire steam plant of their enlarged and remodeled electric light station. The order includes one 50 horse-power Armington & Sims automatic cut-off steam engine, two 50 horse power steel boilers, two Jarvis boiler settings for same, two sets Sheffield grates, Korting injectors, etc. It is expected that the plant will be in operation early in April.

THE contract to build the Charlotte, Mich., waterworks has been awarded as follows: Construction of works, entire, outside of engine house, was awarded to the National Tube Works Company, Chicago, for $30,000; the contract for furnishing everything inside the engine house, including pumping engine, boilers, etc., was awarded to L. M. Walker, of Port Huron, for $5,000. This leaves a balance of $5,000 from the original appropriation for the erection of an engine house and general improvements.

THE contract has been let for the construction of the building for the Selma, Ala., water-works.

STERLING, Ill., has contracted for water-works to cost $80,000; and is to have street cars also.

A COMPANY is being organized at Chestertown, Md., to erect gas works. C. L. Westcott can give information.

The Boston Bridge Works are making preparations for the erection of the iron bridge which will carry the pipes of the Pawtuxet Valley Water-Works across the river at Phenix, R. I.

THE Aurora, Ill., water-works were tested recently At 125 pounds pressure two streams were thrown to a height of about 100 feet. The engineer, Mr. Davis, will make further tests which will be final, and if the work throughout is satisfactory it will be accepted from the contractors.

HUNTINGDON, PA., March 3.—A hitch has arisen between Peter Herdic and the Council in reference to the completion of the water-works. At a meeting held last evening Mr. Herdic notified the Council that he completed his contract on January 16, and that the first quarterly payment of rent, amounting to $400, would be due April 16. Mr. Herdic has not yet built a reservoir, and the water is pumped through the mains directly into the houses from Stone creek. A majority of the members of the Council held that the contract will not be completed until the reservoir is built, and accordingly notified Mr. Herdic through the City Solicitor that no rent would be paid until that was done.

LOCKPORT'S WATER SUPPLY.

By our special dispatches from Albany to-day, it will be observed that a bill was introduced by Assemblyman L. P. Gordon, of this city, incorporating the Lockport Water Supply Company. The incorporators are John Hodge, Wm. McRae, Wash. H. Ransom, Birdsall Holly, James Jackson, Jr., Chas. Whitmore, Willard T. Ransom, E. M. Ashley, Harvey Gaskill, Jesse Peterson and Wm. S. Camp. The capital stock of the company is not to exceed $10,000,000, at $100 per share. The scheme is to tap Niagara river, between the mouth of Tonawanda creek and the village of Niagara Falls for the purpose of conducting the water down to the head of the gulf west of the city, where it will be used as a water supply for the city. The water now in use is wholly unfit for domestic purposes and two-thirds of the wells in the city are in as bad a condition. By the means already noted a pure, perfect and wholesome water supply can be obtained for our city, of which few places can boast. No definite location for the tapping of the river has yet been determined upon, but in all probability it will be made about a mile below Tonawanda Island. No surveys having been made the general route of the raceway is derived from the geographical condition of the country and maps made by surveyors for ship canals many years ago. The bill includes the right of eminent domain, besides securing a franchise for the company. It grants the privilege to convey the water to Lockport, discharging the surplus into Eighteen Mile creek and Lake Ontario. It grants the right to supply other towns and villages in Niagara county, and their inhabitants with water by contract with the company. The company may build or construct canals, raceways, ditches, locks, piers, inlet piers, cribs, bulkheads, dams, gates, sluices, reservoirs, aqueducts, conduits, pipes, culverts, or other works, machinery or buildings of any kind and description for the water supply deemed necessary.

The stockholders can borrow money for construction of works; issue bonds; mortgage its property and franchises to secure payment on same; and increase or diminish its capital stock.

The bill also provides for injury of the works of said company by anyone, by making it a criminal act. The party so doing shall forfeit and pay to the company treble damages, besides the cost of action to be recovered in any court having jurisdiction. The bill cites as the uses to which the water can be turned as follows: For sanitary, municipal, domestic, manufacturing or agricultural purposes.

The principal office of the company will be in this city, and the first election of officers by the stockholders will occur on the first Tuesday in June, 1887. The plan to furnish water to our city is a grand and enterprising piece of mechanical work, to be consummated only by energy and perseverance. Of course the real motive of the bill is a water supply for our city, yet the power that will naturally follow will make one of the greatest in the world, and should it be properly developed will increase the already growing tendency of our city towards manufacturing purposes. The benefits accruing to the county, as well as the city, cannot be well estimated just at present, but certain it is that throughout the western and northern portion of our county, no village or town need be without pure water for sanitary, domestic or fire purposes. The work of building such a canal or raceway to properly conduct the water to our city is but a question of time, and will give us not only one of the best systems of water-works, but also the BIGGEST water power in the world.—Lockport, N. Y. Paper.

KANSAS CITY WATER-WORKS.

More than usual interest attaches to these from their being operated on a combination of the reservoir with a direct supply system, and from the size and topography of the city, which renders the direct fire protection, of unusual difficulty.

When the works were built (1874-5) Kansas City had a population of about 30,000, with a public debt, caused by investment in railroads, etc., big enough for the present city of 160,000; not being able to build works themselves, they contracted with the National Water-Works Co. to build and operate a set of works on the direct supply system, Captain Marvin, then City Engineer, getting in a clause whi h required a reservoir on high ground, and which has resulted in making the works a permanent success.

The water supply was taken from the Kansas river which empties into the Missouri at this point, chemical analysis showing the water of the two rivers to be nearly alike and the Kansas carrying much less sediment than the Missouri. This was against public sentiment and has resulted in a good deal of complaint on the part of consumers. The result to the present time, however, shows that on account of the Missouri having changed its bed very materially, the works, if built as they would have been, would have lost their source of supply, and that the first location under the circumstances, was a good one.

The most enthusiastic believer in the prosperity of the city, however, did not then expect that it would more than triple its population in ten years, and at that time be growing faster than ever. This growth which has compelled the Water-works Company to extend their mains from the first contract of twelve miles to over sixty miles, and increase their pumps from a capacity of 5,000,000 gallons to 14,000,000 gallons per day, has also spread the city till it threatens the purity of the present supply.

For two years or more the necessity of a change in the source of supply has been known to the company and their chief engineer, Mr. G. W. Pearsons, who built the works, and has since made the different additions to them, has been engaged in studying the problem which is now complicated with the supply of Wyandotte, River view, Armstrong and Armourdale, Kansas, cities which it has been proposed unsuccessfully to unite under the general name of Kansas City, Kansas, with the water supply of the whole combined.

In December, Mr. Pearsons submitted to the company, in this city, two plans of supply; one taking the water from the Missouri at a point opposite and above Wyandotte by means of a tunnel under the Missouri, and another taking the supply from the Missouri some three miles further up stream, at a point where the United States Government have guarded the shore with a stone revetment which promises to give permanency to the channel of the river at that locality.

The company appointed a commission of engineers to visit and examine the locality; these determined that the upstream location, although the most expensive, and requiring the different pumping stations to be more widely separated, was on the whole the best, and it has been accordingly adopted, and work commenced.

Nearly 3,000 tons of pipe are ordered from Shickle, Harrison & Howard of St. Louis, on contract previously entered into for this purpose, and it is probable that the season's orders will exceed 7,000 tons. The rest of the work is being pressed with corresponding vigor and when completed will be worthy of extended notice.

THE Corsicana, Tex., Gas Light Co., capital stock, $50,000, has been incorporated by Byron F. Barry, S. R Frost and John R. Miller.

NEWS OF THE WEEK.

Railroads, Bridges and Canals.

The Fergus Falls & Black Hills branch of the Northern Pacific R. R., is to be extended west of Milnor this spring, according to rumors.

Street Railroad for Newburg, N. Y.—The Common Council has granted a franchise for the building of the first street railway in that city. The line will be about four miles long.

The Dallas and Greenville Railway Company has been incorporated in Texas. Capital $800,000. H. M. Hoxie, George C. Smith, Wm. Kerrigan and E. G. Merriam, of St. Louis, and others of Texas are the incorporators.

River Improvement in Alabama.—A board of army engineers spent several days about Tuskaloosa recently, getting up a plan to be submitted to Congress for the improvement of the Warrior river.

The Duluth, Park Point and Southern Railroad Company has filed articles with the Minnesota Secretary of State. The road is to run from Rice Point to Minnesota Point. Capital stock, $500,000. The incorporators are W. L. Banning, Andrew De Graff, Robert A. Smith, F. D. Banning and William Dawson, Jr., of St. Paul.

The Southern Pacific R. R., has commenced, and will complete as fast as possible, probably by March 20th, twenty-two miles of railroad to connect with the new Yosemite wagon road, which will shorten the time between Madera and Clark's seven hours. Instead of fourteen hours stage ride, as formerly, it will then be but seven.

The Canadian Pacific R. R., has definitely selected the head of Burrard Inlet as the site for the western terminus. The place will be called Vancouver, and the construction of wharves and depots will soon be commenced. The track will be extended by the end of June twenty miles from Port Moody.

An Iron Lined Tunnel.—The East Tennessee, Virginia & Georgia R. R., has determined to reconstruct the tunnel under Missionary Ridge, and to make it permanent. It will be arched with boiler plate and made to last for ages. It is estimated that it will require at least two months to make the repairs.

Tehuantepec Ship Railway.—WASHINGTON, Feb. 24.—The Eads ship railway scheme received a bad setback in the House Commerce Committee to-day. The committee held a final secret session and voted certain amendments to the bill, increasing the maximum tonnage proviso to 4,000 where it stood 3,000 originally. The vote stood 6 to 6. The bill, therefore, failed to receive the favorable recommendation of the committee.

The State Line & Stony Point R. R. has been incorporated to build a line from the West Shore road at Stony Point to the New Jersey state line, with prospects of a continuation to Jersey City. It is said the Vanderbilts will build a shore line for the West Shore from Weehawken to where the present route becomes a shore line, abandoning the present line in the rear of the Palisades.

RAILROAD CULVERTS.

The importance of thorough drainage of any roadbed, whether it be that of a railroad, a common highway or a city street, is now so universally acknowledged by everybody, who has even the most primitive ideas concerning a good road, that it is not necessary to further emphasize it. How to drain a road the most cheaply and efficiently, is the problem now to consider. Tile drainage on ordinary highways is recognized as being as much a necessity to a good road-bed, as a brick or pipe sewer is to a city street. For railroads and highways frequent and sufficient culverts are a necessity to carry off the water from the open ditches on either side. Board culverts are now generally abandoned, being used only as a temporary makeshift. At the Highway Commissioners' Convention, held at Springfield, Illinois, April 22d, 1884, the following resolution was carried unanimously:

Resolved: "That we, the Highway Commissioners of the State of Illinois, are satisfied (from practical experience) that Sewer Pipe for Culverts is a decided success, and we would recommend its use wherever practicable as a substitute for board culverts."

Specialties usually pay. The firm of Blackmer and Post, of St. Louis, Mo., several years ago recognized the importance of what the Illinois road makers years after so emphatically endorsed. In 1878, the St. Louis firm commenced the manufacture of double strength culvert pipe, which differed from the standard vitrified pipe, then in general use, only in that it was made heavier and stronger, and the material used was selected with more care. This pipe was made expressly for use by railroads for culverts under their tracks, its use being especially adaptable to rapid construction, and the cost being much less than stone masonry or timber trestle work.

That the result of this departure justified it, is shown in the large increase in the demand for this pipe, since it was placed on the market in 1878, as shown below:

In 1878 they sold of different sizes			11,538 feet.
" 1879	"	"	31,564 "
" 1880	"	"	41,104 "
" 1881	"	"	62,218 "
" 1882	"	"	74,050 "
" 1883	"	"	33,416 "
" 1884	"	"	54,902 "
" 1885	"	"	69,500 "

Most of this pipe has been used by railroad companies for culverts, and the period of depression in railroad building, which set in about 1883, is clearly marked by the falling off in the demand for culvert pipe at that time. The popularity of the pipe is clearly shown, however, in the letters which the firm have received from prominent railroad men, and that the demand continues to increase since 1883.

Parties engaged in railroad construction may serve their interests by corresponding with the manufacturers.

The Deep Sea Hydraulic Dredging Company has been incorporated. Capital, $150,000. The principal office is in New York city.

Chautauqua Lake R. R.—The commission appointed by the Supreme Court to decide between the two surveyed routes for this road, has had one meeting. The railroad company's line followed the edge of the lake, skirting the grounds of the Point Chautauqua Association, and was almost level. The association objected to this location and surveyed a new line, running back of its lands, which would make necessary a grade of about 70 feet to the mile. The company refused to accept this line, and an appeal was made to the courts by the officers of the association.

St. Louis, Kansas City & Colorado R. R.—Chief Engineer S. T. Emerson has finished locating the line from Fort Scott, Kansas, to Missouri, and the contract for grading twenty miles of the road has been let to Frank Anderson, of Vernon county, who has commenced work. After crossing into Missouri, two routes are being considered, one via Arthur and Papensville to Clinton, and the other via Foster and Butler to the same point. From Clinton the proposed route goes via Cole Camp, Versailles, Vienna, Union, Labadie and Creve Cœur to St. Louis, Mo.

Another "South Penn" Move.—Ralph Bagaley, an intimate friend of President Gowen, says that the latter will offer the South Pennsylvania R. R. stockholders such a price for their interest as suits him, and if they do not accept he will build a parallel line to that road from Pittsburg to Harrisburg, costing $10,000,000. If this line is built it will go over the mountains, have no tunnels, secure easy grades, and will give, through Gowen's influence, the Baltimore & Ohio fair rates over the Jersey Central between Philadelphia and New York.

The Arthur Kill Bridge.—The New Jersey Senate on the 9th, passed the bill to prohibit the bridging of Staten Island Sound by the B. & O. R. R., without the consent of the Legislature. A report on the traffic in the Kill for the last fifteen days showed that with the exception of two days the entire length of the Sound had been open for traffic; that the average number of craft passing the site of the proposed bridge had been five tugs with attendant tows going east, and eight tugs and scows going west: that with the exception of two steamers which ply regularly from New Brunswick to New York, nearly all of these had pipes and stacks not above the average of 32 feet—the height of the bridge—so that they could have passed without interference: that on several days the commerce amounted to only two tugs, and these of the Pennsylvania or Lehigh Railroad. In contrast to the statement of the meagreness of the commerce to be affected, Mr. Wiman presented to Senator Frye some elaborate statistics indicating that the commerce to be benefited by the erection of the bridge consisted of that centering in the harbor and city of New York amounting in round numbers to the enormous total of $2,100,000,000 per annum, all of which employed now eight distinctive channels of transportation; that the addition of this bridge would give a ninth avenue and entitle it to its proportion of over $200,000,000 per year. Some idea, therefore, of the commerce to be benefited, it was claimed, may be formed from the fact that this sum amounts to more than the total imports and exports of Boston, Philadelphia, and Baltimore combined.

The Board of Trade and Transportation on the 10th passed the following:

Resolved. That, in the opinion of this board, it is advisable under proper restrictions, as to height, character, and nature of the structure, to authorize by act of Congress the bridging of the Arthur Kill at a point below Elizabethport, but that such bill shall contain when enacted into a law the restrictions now provided in Senate bill No. 121 as to height, draws, and public use, and such additional restrictions as to location as may be necessary to protect the interests of the commerce of the Arthur Kill.

Kentucky and Indiana Bridge Company.—The steel superstructure of this bridge is up from Pier No. 4; the North Anchorage Pier, to 140 ft. beyond Pier No. 7, covering the following spans: Between Piers Nos. 4 and 5, 260 ft., between Piers Nos. 5 and 6, 480 ft. cantilever span, between Piers Nos. 6 and 7, 390 ft. and 140 ft. of cantilever arm, extending beyond Pier 7. The span of 260 ft., between Piers No. 8 and 9 is also up, and work is progressing with the cantilever arm extending towards Pier No. 7, this span probably being completed in two weeks. When done, it will leave only the span of 240'.0 between Piers No. 1 and 2, and the draw of 370 ft. between Piers 2 and 4, to be raised to complete the structure. The contractors are now raising the false work for the 240 ft. span, having it half up, and will begin on the draw as soon as the water will permit them. The north approach trestle is complete, and the highway, and a large portion of the railway trestle on the south approach is also finished. C. A. Brady is the engineer-in-charge.

Electric Cable Street R. R.—The city of Los Angeles, Cal., has granted the franchise for an electric cable street railroad for a period of 30 years, to Charles H. Howland. The ordinance is published in full in the Los Angeles *Daily Herald*. We are assured by private letter that the backers of the enterprise are substantial business men of Los Angeles and San Francisco, who are engaged in most of the enterprises of those cities.

The Keithburg Bridge, over the Mississippi river was opened for traffic Feb., 22. A Central Iowa passenger train crossed at 2 P. M. The following gentlemen were present at the opening, E. E. Dudley, General Manager Central Iowa Railway: John F. Wallace, Construction Engineer of Central Iowa Railway; E. Duryea, Engineer of Keithburg Bridge Company; H. L. Fort, See Phœnix Bridge Co.

Harlem River Improvement.—Senator Evarts introduced in the Senate, on the 17th ult., a joint resolution similar to one pending in the House of Representatives, authorizing the Secretary of the Treasury to contract with Charles Stoughton for the improvement of the Harlem river. It provides for the construction of a channel 225 feet wide and 15 feet deep at mean low water from the Hudson to or near the upper end of Randall's Island. Mr. Stoughton is to furnish the right of way free, and is to be paid not more than $1,295,000, using the $400,000 already appropriated.

Underground Railroads in Brooklyn.—The three companies proposing to furnish underground rapid transit for Brooklyn, (South Ferry and Seaside Direct Transit Company, Tunnel Extension Railway Company and Bridge Tunnel Railway Company) have been consolidated under the name of the Brooklyn Sub-Railway Company, with a capital of $2,050,000. The directors are Charles G. Francklyn, Charles A. Sackett, Harrison E. Gawtry, Henry Y. Attrill, Phillip Allen, James McMahon, William H. Murtha and others. Charles A. Sackett is President, and Charles G. Francklyn Vice-President of the corporation. The directors say that they have already obtained the majority of consents on Atlantic and Flatbush avenues, and that a road will be constructed in those thoroughfares as soon as the consent of the Common Council is obtained.

A Proposed Great Bridge.—General Manager Jeffrey, of the Illinois Central Railroad said recently concerning the bridge which his company has asked permission of Congress to construct across the Ohio river at Cairo, that he could only give a general idea of what the bridge would be, but that its construction would be one of the greatest engineering feats of the age. Its cost would probably be about $3,000,000. The bridge will have only a single track and will be about 5,000 feet long, exclusive of the approaches, which will be as much longer. It will be built of steel and will rest on solid piers of masonry about 170 feet high from the bottom of the foundation to the capstone. At least three of the spans will be 500 feet in length and the length of the remaining spans will depend on the relative cheapness of span work and masonry—that is, whether it is cheaper to build short spans and many piers or longer spans and fewer piers. It will not be a cantilever or suspension bridge, but a truss bridge of the heaviest and most approved pattern. It is not yet settled whether it will be built with fixed spans or with one draw span; that will be decided by the result of the conference with the War Department. If it is to be a fixed span bridge, it will, of course, be somewhat higher than if built with a draw span. There is a difference of about 50 feet between the high and low water levels at Cairo, and an extensive "bottom" at the confluence of the Ohio and Mississippi rivers, across which the Illinois Central R. R. extends a distance of six miles on the Illinois side of the river. On the Kentucky side this "bottom" extends for four or five miles, to the foothills, so that in high water there is nothing above the surface except the Illinois Central tracks and the treetops. Under such circumstances it will be seen that the building of the bridge is an enterprise of no ordinary difficulty.

The Forth Bridge.—On February 16 the half-yearly meeting of the Forth Bridge Railway Company was held in the offices of the North British Railway Company, Edinburgh, Mr. John Dent presiding. The chairman, in moving the adoption of the reports, said the works of the bridge were progressing satisfactorily, the foundations being very nearly ready for the superstructure. He congratulated the shareholders on the very successful way in which the foundations had been laid, and expressed the hope that the superstructure might go on equally favorably. The engineer's report stated that the twelve great piers for carrying the 1,700 feet spans were finished, with the exception of a few courses of masonry on the Inchgarvie southeast pier and the Queensferry northwest pier, the work on the latter pier being much delayed by the tilting and subsequent bursting of the caisson. All the other piers were built to the height of the underside of the viaduct girders. On the north side of the Forth the five girders

Laying Water Mains.—The following bids have been received and awards made by the Department of Public Works, New York:

Laying water pipes on 9th, 8th, St. Nicholas, Madison and New avenues, 145th, 116th, 97th, 87th, 72nd and 70th streets.

Names.	1,000 cu. yds. Rock Excavation.	14,000 cu. yds. Earth Excavation.	14,100 cu. yds. Earth Filling.	16,200 lin. ft. 12-inch pipe.	11 12-inch Stop Cocks and Boxes.	43 6-inch Stop Cocks and Boxes to set.	37 Hydrants to set.	10 cu. yds. Brick Work.	3,400 sup. yds. Pavement and Flagging.	700 lin. ft. curb and gutter.	9,500 lin. ft. 6-inch pipe.	Totals.
F. Thileman, Jr.	1.50	.25	.8	.30	6.00	5.00	5.00	2.50	.20	.5	.18	$13 904
G. Borstman & Cornwell	2.00	.20	.5	.28	6.00	4.00	6.00	1.00	.15	.2	.20	12,935
J. Cornwell, Jr	1.50	.15	.6	.34	5.00	4.00	5.00	1.00	.21	.1	.24	13,377
J. W. Phelan	2.75	.22	.15	.33	10.00	7.00	7.00	10. *	.15	.6	.20	16,513

The proposal of Borstman and Cornwell being the lowest formal one received, was accepted and transmitted to the Department of Finance.

Laying water pipes on Fairmount, Tremont, Prospect and Riverdale avenues.

Names.	950 cu. yds. Rock Excavation.	7,500 cu. yds. Earth Excavation.	7,600 cu. yds. Earth Filling.	5,800 lin. ft. 12-inch pipe.	8,700 lin. ft. 6-inch pipe.	2 12-inch Stop Cocks.	9 6-inch Stop Cocks.	21 Hydrants to set.	3 cu. yds. Brick Masonry.	200 sq. yds. Pavement, etc.	60 lin. ft. Boxing 12-inch pipe.	60 lin. ft. Boxing 6-in pipe.	200 lin. ft. curb and gutter, etc.	Totals.
A. Emery	2.00	.20	.14	.38	.20	5.00	3.00	8.00	25*	.10	3.00	2.00	——	$ 8,933.75
J. Cornwell, Jr.	2.50	.12	.06	.37	.26	4.00	3.00	5.00	2.00	.12	1.50	1.10	.02	8,469.00
G. Borstman, etc.	3.50	.25	.10	.35	.25	6.00	5.00	5.00	2.00	.20	1.50	1.50	.02	10,557.00
F. Thileman, Jr.	3.00	.30	.05	.40	.25	10.00	5.00	10.00	2.50	.20	5.00	2.00	.05	10,727.50

The proposal of J. Cornwell, Jr., being the lowest formal one received, was accepted and transmitted to the Department of Finance.

*These figures are taken from the list of bids open for inspection at the Department of Public Works.

were being raised gradually to the required height, and although the length of the girders is 800 feet, and the weight 1,000 tons, they were lifted in one piece by the hydraulic appliances provided as easily and as safely as a small girder was lifted by an ordinary crane. On the south side of the Forth the viaduct girders were ready to be lifted in the same manner. During the past six months about 6,500 tons of steel had been delivered at Queensferry. The report was adopted, and the meeting authorized the conversion into stock of the existing shares in the capital of the company. Mr. James Hall Renton was re-elected a director and Mr. J. Wyllie Guild an auditor. The shareholders then resolved themselves into a special meeting, and approved of a bill proposed to be introduced into Parliament for the purpose of extending the time for the completion of the Forth Bridge Railway. The proceedings then terminated.

CONTRACTING.

A Wyoming Capitol.—A bill has been introduced in the Legislature for a $100,000 capital at Cheyenne.

Bridges.—S. H. Tucker has contracted to build three bridges in Archuleta county, Col., for $2,500.

Jail.—Bids will be received until April 1st, by F. W. Kaufman, Lexington, C. H., S. C., for building a jail at that place.

Sidewalk.—Sheppard & McCarty, Macon, Ga., have received the contract to lay $1,189 worth of granite sidewalk in that city.

Iron Wire.—Proposals for 2,000 pounds of galvanized iron wire will be received until April 2nd, at the Navy Pay Office, Post Office Building, Boston.

Hemp.—Proposals for the supply of specified qualities and quantities of hemp at the Boston Navy Yard will be received at the Navy Department (Bureau of Equipment and Recruiting), Washington, D. C., until April 2nd.

Rectification of the South Platte.—The City Engineer, of Denver, Col., is preparing plans for the rectification of and confining to respectable limits the channel of the South Platte river in its course through the city.

Taking Down Brickwork.—The Commissioners for the erection of a new Court House for Suffolk county, Mass., will receive proposals until March 20 for taking down, cleaning and counting the brick, and for the purchase of material of buildings to be taken down.

Lighting.—Proposals will be received until April 1st, prox., for lighting the city of Asheville, N. C., with electricity or gas. Lighting area about one and one half miles square; population 6,000. G. W. Scott, N. W. Girdwood and A. Rankin compose the committee on the matter.

Iron Bridge.—The contract for the iron superstructure for a bridge over Little Creek, near Kent, Jefferson county, Ind., has been awarded by the Board of Commissioners to the Wrought Iron Bridge Company, Canton, Ohio, at $20.40 per foot. There were fourteen bidders in all, the highest bid being $28.46.

Telegraph Poles and Fence Posts.—Mr. James Allan has contracted to supply the C. P. R. R. Co's air line between Smith's Falls and Montreal with 2,500 telegraph poles and 75,000 fence posts. Parties all the way from Franktown to Sharbot Lake are sub-contracting with farmers and others for their delivery.

Wooden Bridge.—The Board of Commissioners of Arapahoe county, Col., have awarded the contract for the erection of a wooden bridge across the Platte river below Riverside to George Platfoot. His bid was $1,545.

Insane Asylum Annex.—Proposals will be received by Irving B. Eldridge, chairman of the Committee of the Board of Supervisors of Monroe county, N. Y., until March 18, for building the Annex to the County Insane Asylum, according to drawings and specifications prepared by the architects, Ellis Brothers, 140 Powers Block, Rochester, N. Y. The building is to be completed by September 1st. Bids are to be made for the entire work and to be left with the County Treasurer, Alex. McVean, addressed to Mr. Eldridge. James H. Brown is Secretary of the Committee.

Bricks, Cement and Sand.—Proposals for the following materials for the new State, War and Navy Departments, Washington, D. C., will be received at the Office of Building of these departments until March 17th:

1.—1,500,000 best red and arch bricks, and 10,000 best red skew back bricks.

2.—3,000 barrels natural hydraulic cement, and 75 barrels Portland cement.

3.—1,300 cubic yards river sand.

The Flynt Building and Construction Company has the contract for the erection of extensive thread works in Newark, N. J. The two main buildings will each be 300 feet long, and besides these the contract calls for a counting-room, engine-house, boiler-house and a steam stack 175 feet high. The contract price is over $100,000. The work is to be started at once as the roof of the mill must be on by July 1st. The company has also contracted to put in a stone dam at Jewett City, Conn., to replace one washed out by the recent freshet.

Timber.—The following bids for timber for gates and wickets of lock and dam No. 6 have been received at the United States Engineer's Office in Charleston, W. Va.:

Martz, Kulp, McWilliams & Co., Coalburg, W. Va., 87,000 feet of oak at $22 per 1,000 feet; 6,000 feet of pine, $25 per 1,000 feet.

Archibald Young, Charleston, W. Va., oak, $23.50 per 1,000 feet.

Humbiod, Sliger & Co., Charleston, W. Va., oak, $29.50; pine, $29.50 per 1,000 feet.

Samuel D. Cox, Charleston, W. Va., oak, $24.95 per 1,000 feet.

M. A. Carroll, Scott, W. Va., $29.50 per 1,000 feet.

Street Paving.—Bids for paving in Savannah, Ga., were as follows:

E. T. Vietts—Curbing, 68 cents.

Stone Mountain Granite Company—Granite blocks, $2.12½ per square yard; curbing, 35 cents per lineal foot.

A. C. Haskett, Waynesboro, S. C.—Granite blocks, $2.65 per square yard; curb, 70 cents per lineal foot.

S. H. Venable & Co.—Granite blocks, $2.30 per square yard; curb, 41 cents per lineal foot.

B. D. Walker—Curb, 50 cents per lineal foot.

John Maxwell & Sons, Philadelphia—Asphalt $1.97 per square yard; curb, 63 cents per lineal foot.

Patrick Maloney, Washington, D. C.—Asphalt, $2.50 per square yard; curb, $1.27 per lineal foot.

G. A. Dening—Granite blocks, $3.71 per square yard; curb, 78 cents per lineal foot.

H. W. Warren—Sheet asphalt, 2½ inches on concrete, $2.10 per square yard, curb 52 cents per lineal foot.

C. Myers & Co.—Granite blocks, $2.37 per square yard; curb, 38 cents per lineal foot.

Cartage of Imported Merchandise.—Proposals will be received at the Treasury Department, Washington, D. C., until April 14th for the cartage of imported merchandise at Boston.

Rip-Rap Stone.—The following proposals were received by Major Peter C. Hains, Corps of Engineers, for furnishing 3,000 cubic yards of rip-rap stone: S. Shoemaker, Washington, D. C., $2,160; G. Vanderwerkin, Georgetown, D. C., $2,550; H. P. Gilbert, Georgetown, D. C., $2,250. The first mentioned bid has been accepted.

Cleveland Elevated Roadway.—C. G. Force, the City Engineer of Cleveland, O., advertises this week for the construction of the iron superstructure and trestle work for the elevated roadway from Hill to Abbey streets. It will be 3930 feet long, 57 feet wide and from 30 to 100 feet high. The proposals must be in by March 20th.

Steel Rails.—We understand that negotiations have been closed with Cooper, Fairman & Co., of Montreal, for the supply of 4,000 tons of steel rails for the Brockville and Westport Railway, which will be sufficient to lay the whole track. The rails are from the works of Campbell, of Sheffield, England. They are to be delivered in Brockville during June, July and August. Cooper, Fairman & Co. will also supply the barbed wire for the fencing of the line.

The Colorado Capitol.—W. D. Richardson, of Springfield, Ill., the lowest bidder for the erection of the Colorado Capitol will evidently have a hard row to hoe before securing the award of the contract. No award has yet been made—the commissioners having postponed the matter until they can examine certain Colorado quarries. A large mass meeting was held recently and strong resolutions adopted recommending the employment of home contractors, labor and material.

New York City Contracts.—Proposals will be received by the Fire Department until March 17th, as follows:—For completing and finishing the new building of the Department at Sixty-seventh street; for furnishing and erecting a steam-heating apparatus in the same; for 8,000 feet of 2½-inch Baker cotton rubber-lined hose with standard couplings, and for 8,000 feet of 2½-inch Eureka cotton rubber-lined hose with standard couplings.

The Department of Public Works will receive proposals until March 18th for stop-cocks, stop-cock boxes and covers, and hydrants.

Court House and Jail.—Sealed proposals will be received by Thomas D. Meads, Clerk of the Board of Supervisors of Houghton county, Mich., at his office in the village of Houghton, in said county, until noon of the 28th day of March, for the furnishing of labor and materials for the building and completion of a Court House, Jail and Sheriff's residence for the said county, in accordance with the plans and specifications of the same; which may be seen at the office of J. B. Sweatt, Esq., Marquette, Mich., until the said 25th day of March. Bond, $40,000.

House of Correction.—Proposals for the furnishing of materials and construction of the State House of Correction and branch of the State Prison in the Upper Peninsula, Michigan, at Marquette, Mich., will be received by the Board of Commissioners until April 28th. Plans, specifications and instructions to bidders may be seen on and after the 15th of March, at the office of the Board of Commissioners, Marquette, Mich., and at the office of the architects, Wm. Scott & Co., Nos. 4 and 5 Wayne County Savings Bank Building, Detroit, Mich. Geo. P. Cummings, Secretary, Marquette, Mich.

Market Report of Engineering Materials.

New York March 11, 1886.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.		
Angles	2.00c	@ 2.10c
" steel	2.35	@ 2.45
Tees	2.35	@ 2.40
Beams and channels, American	3.0	@
Tank Plates	2.0	@ 2.1
Shell Plates	2.4	@ 2.5
Steel plates, Tank	2.5	@
WROUGHT-IRON PIPE., PITTSBURGH.		
Butt welded, black ..Discount	42½	@ 45
" " galvanized "	32½	@ 35
Lap welded black "	60	@ 62½
" galvanized "	42½	@ 45
Boiler tubes "	55	
RAILS.		
Steel (large lots at mill)	$34.00	@ $34.50
Old rails	21.00	@ 21 50
Old rails, steel	22.00	@ 23.00
R R. spikes	2.40c.	
R R. splice-plates	2.00	
R R. track bolts, square nuts	3.00	
Barb-wire fencing, galvanized		5.00
" painted		4.00
Corrugated iron		
Nails		
Iron, per keg		2.55
Steel do.		2.75

METALS.

COPPER.		
Lake Superior	$11.40	@ 11.50
Other Brands		10.12
LEAD.		
Com. Domestic	4.80	@ 4.90
Lead Pipe	.06¾c.	
Tin-Lined Lead Pipe	.15	
Sheet Lead	.07¼	
ZINC.		
Sheet	$5.15	@ 5.25

BRICK.

Cargoes (afloat)		
Haverstraw per M.		
Fishkill		
Up-River		
Jerseys	6.75	@ 7.25
Long Island	7.50	@ 8.50
Pale	4.50	@ 4.75
FRONTS.		
Croton, red	11.00	@ 14.00
" dark	11.00	@ 14.00
" brown	10.00	@ 13.00
Philadelphia pressed	24.00	@ 25.00
Trenton "	24.00	@ 25.00
Baltimore "	37.00	@ 41.00
Buff "	33.00	@ 35.00
Enameled English	65.00	@ 130.00
" American	85.00	@ 120.00
Fire brick	24.50	@ 55.00

CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be Wholesale in New York, subject to such special rates as large quantities may warrant:

Alsen's Portland Cement Works	$2.50	@ $3.00
BAETJER & MEYERSTEIN:		
Hanover Portland	2.60	@ 2.65
BELLONI & Co.:		
Hemmoor "Crown" brand		2.50
JAMES BRAND:		
K. B. & S.	2.55	@ 3.00
BROOKS, SHOOBRIDGE & Co.	2.45	@ 2.60
HOWARD FLEMING:		
Gibbs' English Portland, 400 lbs.	2.65	@ 2.90
K. B. & S. " "	2.75	@ 2.95
Stettiner, German	2.65	@ 2.85
Lagerdorfer, "	2.45	@ 2.75
Fieve, A 1, Belgian	2.35	@ 2.50
Roman	2.75	@ 3.00
Keene's Coarse	4.75	@ 5.50
" Fine	7.75	@ 8.50
" Superfine	8.50	@ 10.00
FISHER, ERSKINE W.:		
Stettin (German) Portland Cement	$2.40	@ 2.75
GABRIEL & SCHALL:		
Vorwohler "Lion"	2.65	@ 3.10
HUDSON RIVER CEMENT Co. Rosendale		1. 0
JOHNSON & WILSON:		
Saylor's American Portland	2.15	@ 2.40
LESLEY & TRINKLE, Philadelphia, Pa.:		
"Giant" Portland	2.20	@ 2.40
Improved "Union"	1.35	@ 1.50
Union	1.10	@ 1.20
MARCIAL & Co.:		
J. B. White & Bros. Coarse	4.50	@ 5.00
" Fine	8.00	@ 10.00
" Portland	2.45	@ 2.85
NEW YORK CEMENT Co.:		
Rosendale		1.20
N. Y. & ROSENDALE CEMENT Co.:		
Rosendale "Bridge" brand		1.10
SINCLAIR & BABSON:		
K. B. & S.	2.35	@ 2.60
STANDARD CEMENT Co.		
E. THIELE:		
Dyckerhoff	2.90	@ 3.25
UNITED STATES CEMENT Co.:		
Windsor	1.00	@ 1.10
Standard		1.15
Coh 's Portland	2.15	@ 2.40
UNION AKRON CEMENT Co.:		
Akron "Star" brand.		

ASPHALT.

Prices range per ton	$15.00	@ 20.00
According to quantity or brand, and whether taken from vessel or store.		

LIME.

Rockland, common per bbl	1.00	
" finishing	1.20	
State, common	.90	
" finishing	1.10	
Kingston, ground	95	@ 1.00
Add 25c. to above figures for yard rates.		

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.95	@ 1.00
" " No. 2 "	0.75	@ 0.85
" " light drab "	0.80	@ 0.95
Berlin " in rough "	0.75	@ 1.00
Berea " " "		
Brown stone, Portland, Ct. "	1.00	@ 1.35
" Belleville, N. J. "	1.00	@ 1.35
Granite, rough	0.45	@ 1.25
Common building stone per load.	2.00	@ 3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40	@ 3.00

SLATE.

Purple roofing per square.	6.00	@ 7.00
Green "	6.00	@ 7.00
Red "	15.00	
Black Penna. (at New York) "	4.50	@ 5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	18.00	@ 20.00
Choice	65.00	@ 70.00
Tally plank, 1¼ in.10 in. dres'd, each.	.44	@ .50
Tally boards, dressed com. "	.28	@ .30
SPRUCE, Boards dressed "	.25	@ .28
Plank, 1¼ in "	.28	@ .30
" 2 in. "	.38	@ .40
" 2 in. dressed "	.43	@ .45
Timber per M.	20.00	@ 22.00
HEMLOCK, Boards each.	.18	@ .20
Joist, 2½ × 4 to 4 × 6 in	.16	@ .44
OAK per M.	55.00	@ 65.00
CYPRESS 1, 1½, 2 and 2½ in "	35.00	@ 40.00
YELLOW PINE, Girders "	25.00	@ 30.00
Dressed flooring "	28.00	@ 35.00
SHINGLES, Extra shaved pine, 16in. "		
" sawed 18 in. "	5.75	@ 6.00
LATH, Cargo rate	2.40	

PAINT.

Lead, white, American dry per lb	.04½	@ .06
" " " in oil pure "	.06½	
" English, B. B. in oil "	.08¾	@ .08¾
" Red, American "	.05½	@ .06½
Litharge "	.05	@ 05½
Venetian red, American "	.01	@ .01½
Indian red "	.05	@ .10
Vermillion, American lead "	.10½	@ .12½
Paris green "	.15	@ .20
Umber, Amer. raw and powdered per lb.	.01½	@ .01¾
Drop black, Amer. "	.07	@ .13
" " Eng. "	.11	@ .13
Chrome green "	.05	@ 20
Oxide zinc, American "	.03¾	@ .04
" French "	.06	@ .08

Trade Notes.

THERE is a prospect that a Maine company will erect extensive pump works at Chattanooga, Tenn.

THE shipyards along the Delaware river have recently received numerous orders for the construction of both coastwise and river tonnage, and expect to be actively employed throughout the year.

THE Standard Steel Casting Company, near Chester, Pa., will shortly erect a large foundry for making "Baldt" steel in addition to the open-hearth steel they now make.

IT is probable that arrangements will be made soon for the construction of the Bon Air railroad line from Sparta, Ga., six miles out to the coal fields of the Bon Air Company.

THE building contractors of Camden, N. J., will concede the demands of the bricklayers for thirty-five cents an hour, or $3.80 per day, and the adoption of the nine-hour system.

THE Johnston Railroad Frog and Switch Works at Chester, Pa., are now busy on a $20,000 order. They propose to enlarge their works shortly.

THE Roanoke, Va., Machine Works are filled with orders, and are running on full time in both locomotive and car departments.

THE American Tube and Iron Co., Middletown, Pa., is building several new furnaces and a number of threading machines for the purpose of getting out pipe more expeditiously. The mill is now turning out about 150 tons of pipe every twenty-four hours, and they expect to increase the capacity to 200 tons

THE St. Louis, Mo., Rock Drill Company has been incorporated. Capital $150,000. The stockholders are, J. J. Mersman, H. F. Parsons, F. C. Mersman and James Hannerty.

THE South Carolina Railway Company has ordered ten new locomotives for use on its road after the change of gauge on June 1st. They have been ordered from the Baldwin Locomotive Works, and include four passenger engines with 16-inch cylinders and 69-inch drivers.

THE Harlan & Hollingsworth Company, Wilmington, Del., is building 250 cars for a railroad in the Argentine Confederation. 100 are box cars and 150 platform cars.

SUIT has been brought by the Rogers Locomotive and Machine Works against the Southern Railroad Association as guarantors for the payment of $447,000 of the bonds of the Mississippi Railroad Company with interest from 1878. An attachment has been granted against property in New York City belonging to defendants.

THE Southern Bridge Co., at Birmingham, Ala., has put its works in operation.

THE Mallinckrodt Street Car Brake Company, Denver, Col., capital stock, $150,000, has been organized by John Mallinckrodt, Emil Breunert and Josephine Mallinckrodt.

HARRISBURG, PA., March 1.—Among the corporations chartered to-day at the State Department are the American Road Machine Company, of Kennett Square, capital, $250,000; the Automatic Nut Lock Company, of Philadelphia, capital stock, $12,000; the Edison Electric Illuminating Company, of Lancaster, capital, $50,000; and the United Building and Loan Association, of Philadelphia, capital, $1,000,000.

THE St. Charles, Mo., Car Company is building eight box cars, double deckers, fifty feet long, for the Kansas City stock yards; also ten flat cars, of the same length, for the Kansas City, Fort Scott & Springfield Railroad. In the foundry department it has a large contract for car castings, deliveries to be made at Kansas City.

MR. HENRY HAUMAN, of Brussels, Belgium, stopped in Pittsburg recently on his way south, where he is going to locate the site of a large iron and steel plant. He was sent to this country by a powerful Belgian syndicate and is a prominent engineer of that country. While in Pittsburg he met several leading iron men and the various qualities of the "Basic process" were discussed.

THE Northern Pacific Railroad will erect a round-house and machine shop at Tacoma, Wash. T., but it is uncertain when work will commence. Plans have already been made for the buildings. The company's car shop at St. Paul, Minn., will start April 1st with 150 hands. Both shops and machinery are new. The St. Paul, Minneapolis & Manitoba Railroad will erect new machine shops somewhere on their line. They will not enlarge their shops at St. Paul.

THE Brown Hoisting and Conveying Machine Co. has adopted its system for use in excavating for sewers, etc. A plant of this kind has been completed, and will soon be put to practical test on sewer work at Akron, O. Mr. Alexander E. Brown has perfected a curved bridge tramway with adjustable piers, thus enabling the Brown machine to convey material and deposit its load on a line parallel with that of the vessel or car unloaded. Mr. Brown has also perfected a continuous cable tramway for conveying material long distances over uneven surfaces. The New York, Pennsylvania & Ohio Railroad Company has ordered another hoisting and conveying plant for its dock in Cleveland, making the fourth Brown plant purchased by them.

AT Springfield, Ill., the Alta Vista Iron and Steel Company, at East St. Louis, has been incorporated for the manufacture of iron and steel. Capital stock, $100 000. Incorporators, Charles Adams, Stanly F. Ballou, E. W. Curtis and W. H. Garrett. The National Pump-cylinder Company, of Chicago, has filed a certificate of dissolution. The Shelbyville Water and Electric Light Company, of Shelbyville, also filed a certificate of dissolution. The Shelbyville Water and Electric Light Company, of Shelbyville, filed a certificate of change of name to the Shelbyville Water Company.

THE old Gill Car-Works, Allegheny, Pa., have been bought by a number of capitalists, and will hereafter be operated as the Union Foundry and Machine Company, Limited. The new company will manufacture steam, water and gas fittings and general specialties, and have a capital stock of $200,000. The Otto Specialty Machine Company, of Allegheny, has been merged into the new company which is composed of G. N. Hoffstot, Chairman; John A Mitsch, Secretary and F. N. Hoffstot, Treasurer. Mr. Phillips, late of Speer & Co., will be Manager. The company has already secured a number of contracts and has work ahead for some months. The car-shops have been idle for some time.

H. CLAY EVANS, the assignee of the Wason Car Works, has filed a bill for the sale of the works. The bill will be disposed of at the coming term of the Chancery Court, and the sale will be ordered probably early in the spring. The plant will doubtless be purchased by some company able to conduct it on an extensive plan. Since Mr. Evans took charge, even in the present embarassment, the works have been making money.

THE forty-five brick yards at Haverstraw have a capacity for 340,000,000 bricks annually. There are 2,000 men employed besides 300 in the river carrying trade. Ninety-four barges and vessels are constantly employed in transporting the products of these yards. They use 32,000 cords of wood per year, 12,000 tons of coal dust and 4,000 tons of coal. Wages average $2.25 per day. Two hundred patent brick-pressing machines, costing $1,000 each are used. The value of last year's brick out-put was $1,800,000.

THE Holyoke Machine Co., of Worcester, Mass., has recently received orders for the Hercules water-wheels from the following firms: Friend & Fox Paper Co., Lockland, O., three wheels; Putnam Water Works, Putnam, Conn.; Woodville Water Works, Woodville, N. H., two wheels; Denison Paper M'f'g. Co, Mechanics' Falls, Me.; E. W. Chapin, Northboro, Mass., two wheels; Mt. Holly Springs, Pa.; Josiah Perry, Webster, Mass.; Beckett, Louris & Co., Hamilton, O.; Wm. M. Mooney & Co., Montreal, Canada; John Turnbull, Jr., Glasgow, Scotland, three wheels; Peppercll Mfg. Co., Biddeford, Me.; A.W. Ogilvie & Co., Montreal, Canada, five wheels; Tarbell & Harris, Willimantic, Conn.; Hope Co., Hope, R. I.; Agawam Paper Co., Mittineague, Mass.

THE OLD PLAN AND THE NEW.—Mr. James F. Morse, Vice-President of the Security Mutual Benefit Society of New York, No. 20 Broadway, has recently placed insurance to the amount of $100,000 on the lives of ex-Senator Arkell and his son, W. J. Arkell, proprietor of the Albany "Evening Journal" and the "Judge." This insurance has been placed in the above-named and other leading companies doing business on the assessment plan. The annual cost of carrying it will be about $600. In the old life or level premium companies the cost would be six or seven times as much annually. The Arkells are among the leading business men of the country, and their endorsement of this method of life insurance will carry weight in the business community.—"N. Y. World."

[We personally endorse the above Insurance Company, advertised on page iii., and its method by holding $15,000 in our own office. We so far investigated the financial ability of the company before insuring as to satisfy OURSELVES as to the safety of our investment. The insurance is given at cost; the policies are guaranteed by a Trust Company which makes what profit there is.—EN. ENGINEERING NEWS.]